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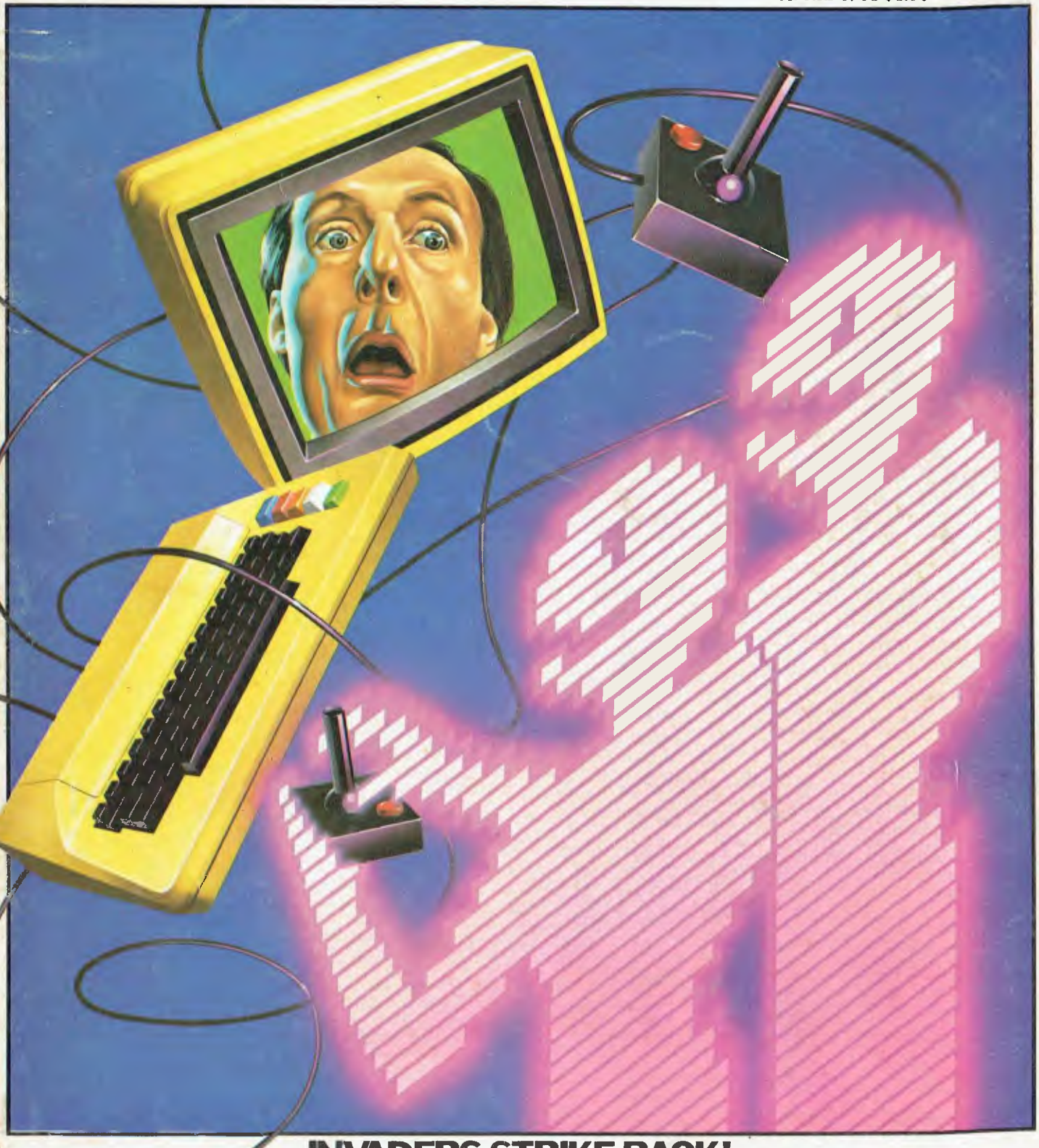

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ZX81

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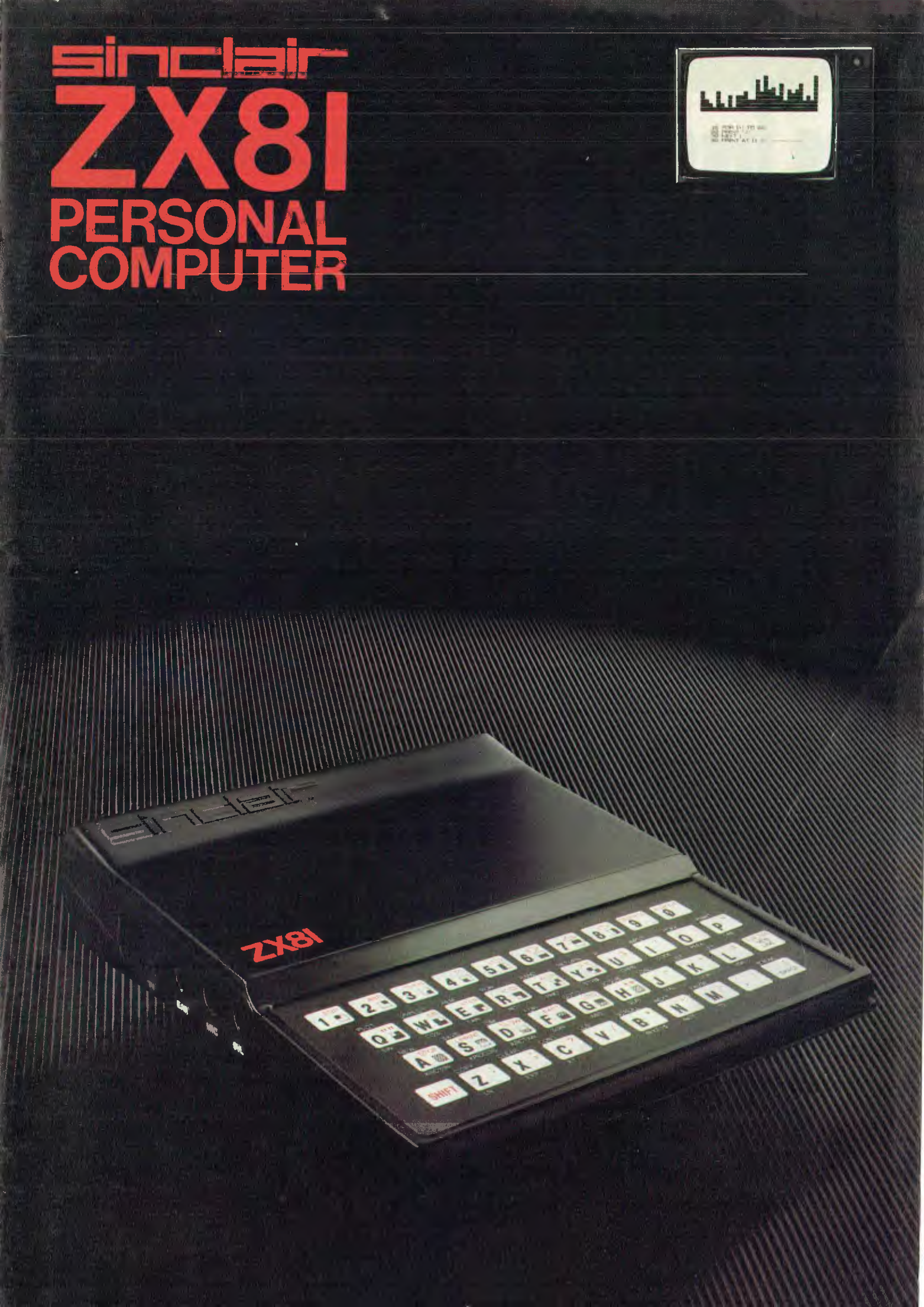

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under $300. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just $199, the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Higher specification, lower price – how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

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Price includes connectors for TV and cassette, FREE manual, sales tax, post and packing (but excludes mains adaptor).

Announcing The Complete Sinclair ZX81 Basic Course –
Takes the mystery out of writing programs! This attractive lay-flat reference manual contains 240 pages of information illustrating the use and possibilities of the Sinclair ZX81:

- How to write programs
- A permanent work of reference
- Numerous examples
- Every function covered

uter-

Available now- the ZX Printer for only $190

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

sinclair ZX81

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	1.2 AMP Adaptor	$17.50	
	ZX Printer	$190	
	ZX paper / 5 rolls	$24.50	
	The complete ZX81 Basic Course	$34.50	
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Sinclair software on cassette.

The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

The ultimate course in ZX81 BASIC programming.

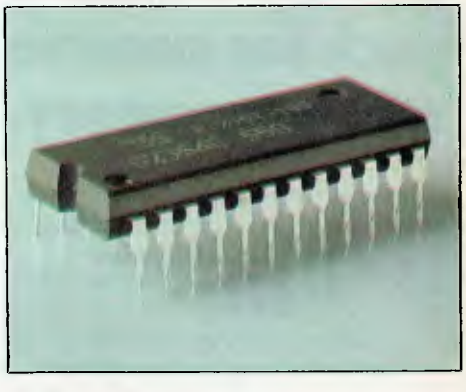
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

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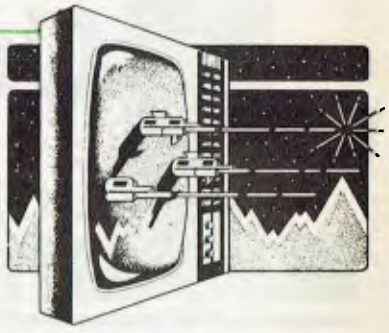
Note to Readers

With the continuing introduction of new models and brands of microcomputers to Australia, it is becoming increasingly difficult for APC to cater for each with a particular page or column. And so, for space reasons, it is better that the columns that have been running to date be dispersed throughout APC in Printout, TJ's Workshop, Communication and Programs. Contributors to the machine-based columns should continue to send material to the columns' authors: C/-APC, 462 Burwood Road, Hawthorn, 3122.
Our thanks to the columns' authors for their contributions over the last year.

FEATURES AND SERIES

18 A MACHINE FOR ALL SEASONS:
News on Commodore's new computer: The Commodore 64.

24 SCREEN PLAY:
Dick Olney reviews games software for the Atari 400. In future issues other popular home computers will be receiving the same attention.



116 ADVERTISERS INDEX:
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111 COMPETITION WINNERS:
We announce the results of APC's printer competition including the twenty runners up who each receive a year's subscription to APC.

86 APC-80:
Ian Davies shows how not to tear your hair out when you've made a syntax error in command mode; for System 80s and TRS-80s.

75 ... V COMPUTERS COMMUNICATE:
This month Steve Leibson looks at Serial I/O, including a description of the industry standard, RS 232.

65 HIGH DENSITY VDU CARD:
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31 ADAM OSBORNE:
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42 ANS BASIC:
The American National Standard for the Basic language contains some powerful and, to those reared on Microsoft products, unfamiliar features. Mike Parr outlines them.

44 PATTERNS:
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49 FRAMES OF REFERENCE:
Continuing Alan Wood's series which explains the facts of micro life to the DP fraternity. This month – how micros should be introduced into firms which already use mainframes, minis or timesharing.

Volume 3 No. 4 April 1982

APC

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REGULARS

6 PRINTOUT:
All the micro news that's fit to print plus some that isn't – including details of a new 3" mini disk drive with a ½Mb capacity and news on the First Australian Personal Computer Show – brought to you by Miriam Cosic.

38 BACK ISSUES:
Catch up with what you've missed (if we haven't sold out of it).

40 NEWCOMERS START HERE:
Our quick intro for those new to computing.

57 TJ's WORKSHOP:
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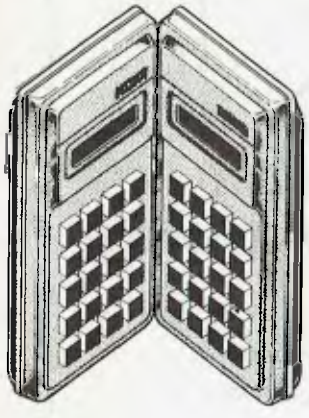
73 SUBSCRIPTIONS:
Cut out the monthly sprint to the newsagent's – have APC delivered to your door.



80 CALCULATOR CORNER:
Hewlett-Packard announces a new networking system for its programmable calculators and desktop computers, plus some powerful peripherals.

82 COMMUNICATION:
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Communication

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After being misplaced last month, JJ Clessa's column is firmly in hand once again.

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89 BENCHTEST 2:
Ian Davies brings the first-ever full test of Applied Technology's Micro Bee.

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017	VIC CUBE	205	BOUNCE OUT	502	DUNE BUGGY
018	MONSTER CHASE	206	MONSTER MAZE	503	SKI-RUN
019	LASER FIGHT	207	HOME INVENTORY	504	THE WORM
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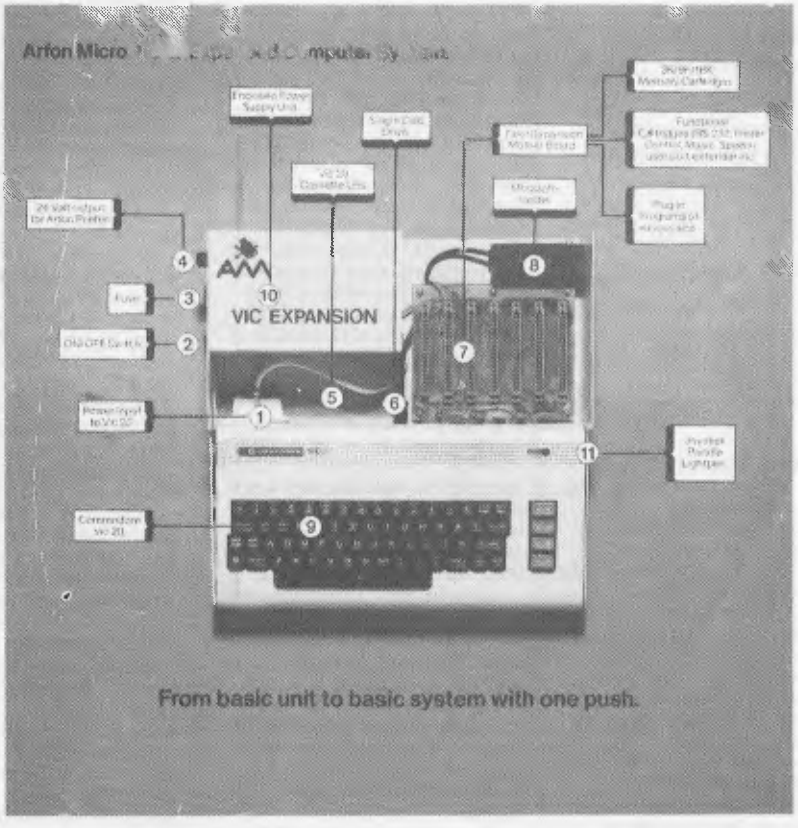
The power pack has an extra 24 volt rail and socket at the side of the shell that will power the new Arfon Micro Printer which is being especially designed for our Vic 20 range.
We wish you continued success with your new Vic 20 system and look forward to any correspondence you may like to send to our users group.



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VIC 20

PRINTOUT

Miriam Cosic and associates report on the latest news from the world micro scene.

16-bit battle takes shape

Two newly released machines are the Canon CX-2 (which was announced last year, and then its Japanese suppliers went very quiet for a long while, because the machine didn't work), and the Sirius 1 (see March Printout).

There is quite a contrast between these two machines. The Canon uses an uncommon central chip, the Motorola 6809, while the Sirius uses the Intel 8088 (the same as that in IBM's Personal Computer).

It also happens that both chips are half-way between the old eight-bit machines (the Intel 8080 and the Motorola 6800) and the new super-powered 16-bit machines, the Intel 8086 and the Motorola 68000. The main difference is that Intel has gone to the trouble of making sure that users can move from this 'stepping stone' to the big chip (Motorola has not), while Motorola has produced a big chip which is actually several degrees more sophisticated than the old (Intel has not, yet).

So the companies are about level overall, with first the one, then the other having the more modern chip.

On the one hand, anybody prepared to wait a year can get a better chip than is on offer today. On the other hand, anybody who waits a year will have to have something for the rest of us to buy this year, and will want to grab the most effective chip available.

At the moment the 6809 has been available for a lot longer than the Intel 8088, and should logically have sold more chips. Converting systems from the 8080 to the 6809 would have been a hard task, harder than converting to the 8088 (because of XLT-86 which converts 8080 source code to 8088 or 8086 source code). Although Intel produced both 8080 and 8088, and though the numbers are similar, there is no similarity between them. Software which runs on one will not run on the other, and you can't plug the new one into the empty socket on the old boards. Without starting the philosophical argument as to why, it seems certain that people using the 6809 have been less effective in getting products to market than have IBM and Sirius with Intel's 8088.

Canon is a good example of what can go wrong. The machine first appeared with its essential operating software more than a year ago and then could not be released onto the market because that software was faulty.

A year ago, the 6809 was a very powerful micro engine. A machine with that chip plus 128 kbytes of memory was a winner, because it would have twice the internal storage capacity of any 8080-based system, a great deal more processing power and the ability to work on longer words.

It is often suggested that a 16-bit word length isn't significantly more important than an 8-bit one and that what really counts is the program which the chip runs.

This simply isn't true.

In a really powerful, comprehensive word and text processing program, the computer has to keep track of simple characters, and keep them in order on the screen, no matter what order they occur inside the computer memory. It also has to keep track of flagposts, such as paragraph indents, special boldface type or underscore words, superscript and subscript notation, and printing commands such as new pages, proportional spacing, and so on. It is also nice to be able to use the text to index the document automatically. All these things are possible with an 8-bit design, but are far easier, and far quicker, on a 16-bit design.

Even at its simplest, a sixteen-bit code can contain a character and 255 different 'characteristics' such as type face, and so on.

Another advantage of 16-bit engines, frequently overlooked by the 'do we really need them?' brigade, is that most can address vastly more memory than 8-bit machines. You can therefore keep a larger amount of text in memory if you're processing words, which is easier and quicker than shuffling it to and from disk.

The actual power increase of the 6809 over the 8080 and its older brothers can be illustrated by the release last year of the Unix operating system by South West Technical Products. SWTP called it Uniflex (because it differed very slightly from the Bell Telephone original, and for copyright reasons). Uniflex turned out to run acceptably fast, according to experts who were used to Unix.

But it is accepted by most operating system designers that ordinary 8-bit systems would take so long to work their way through the Unix system that they would almost never get round to running any software the user wanted. So, although the 6809 has many characteristics of an 8-bit micro, it also has enough of the nature of a 16-bit machine to run an operating system which was designed for 16-bit Digital Equipment minis.

If the 6809 is to succeed it must appear in sufficient different machines — and those machines must be sold in sufficient numbers, to attract software writers. Software writers are very pragmatic: they use the machine they have in front of them and, if they think they can sell the code they have written they will. But if they find that there are only two or three other users in the country, then they won't bother.

The IBM micro is selling in enormous numbers, and other microcomputers use the same 8088 chip or its big 8086 brother. These are now appearing on the market in twos and threes, and some of them are already selling in tens and hundreds.

If the Canon had been on the market, actually selling in tens and hundreds, for the last year, there would now be several thousand, all attracting their programmer owners to write code for their colleagues. But it has been under wraps for a year — and now it is neither ultra-modern, nor particularly powerful, nor particularly cheap. A year ago, it was all of these.

All other things being equal, the 6809 chip would, nonetheless, now start appearing in greater numbers than the Intel 8088. However, IBM's choice of the 8088 means that all things are no longer equal, nor is there any chance of their becoming so.

The next chapter, now unfolding before our eyes, is the emergence of the true 16-bit chips, starting with the relatively primitive 8086, and moving up through the Intel family with the iAPX 286.

The difference between the 8086 and the chip inside the 286 processor are enormous, but they don't get in the way of old software. With people moving from the old 8-bit 8080 to the 8088 or 8086, the problem was literally one of translating all the software in the new vocabulary used by the bigger chip. But the 8086, although bigger than the 8088, has the same instruction vocabulary and so does the even more sophisticated iAPX 286, officially announced in February, by Intel.

This processor is not a single chip. It obeys the same instructions, but needs a totally different circuit board to power it up and feed it signals. Having done that, the system builder gets six times the processing speed of the 8086 and 16 times as much memory — 16 megabytes worth — to load programs into. More to the point, programs running in that large block of memory are watched and monitored by the electronics of the processor, rather than having to be monitored by the system builder's own operating system.

The important effect of this is that a user can now look forward to the day when his systems runs two or three

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more different operating systems — such as CP/M, Unix, Pick and Pascal — simultaneously, without any confusion. And this means that if your word processing package runs under CP/M and you want to link it to a communications package that calls up remote computers automatically under Pascal and pass information to a Unix-based database manager, then this can (theoretically) be done. On the current range of 16-bit micros, it isn't even theoretically possible, because they don't have the iAPX ability to segment its memory, translate program addresses and protect data in the segments.

Motorola, perhaps a bit behind on the 6809 compared to Intel's 8088, has a lead in the true 16-bit market. Its 68000 is now appearing in commercially available systems, culminating in the Radio Shack (Tandy) announcement of an upgrade for its Model II micro, using that chip.

This machine already has the ability to segment and manage its memory — or would have if Motorola could produce more than a few samples of the important memory management chip — and is regarded as more sophisticated than anything Intel can make today, or perhaps for the next year.

However its life is not all mapped out in terms of sweetness and roses, because behind the 68000 there is already a much more powerful 32-bit processor available from National Semiconductor. And several companies now have systems with this 32-bit chip working (in prototype). Zilog's Z8000 family is not much less sophisticated than Motorola's 68000, and that company is known to be working on the next family too.

Don't do anything so stupid as betting that the 6809 is therefore dead, or at least doomed to the obscurity of technological ideas such as the 72rpm record. But on the other hand, don't bet on seeing more 6809 chips than Intel 8088 ones, either.

Not so mad Max

Computer Max, who we hope is no relation to Mad Max, has opened up shop in Brookvale, NSW. Capitalising on the fame of electronics king Dick Smith, the company is promoting itself with the line: "You all know (Electronic) Dick, now meet Computer Max."

Ignoring the ribald implications of (Electronic) Dick, all we can say about Max is the new Osborne 1, the Hitachi Peach, Apple and a Toshiba system.

To lure in sales prospects, Max is giving every visitor to the shop the chance to win an Atari 400 micro. Max is at 539 Pittwater Road, Brookvale, NSW (ph: 02 93-1383).

Apple Logo

When teaching people to program, it's tempting to make it as easy as possible and start with Basic. Not everybody agrees this is a good idea, because of the habits of thought which get learned (unconsciously) along with that language and which can prevent the programmer from ever becoming as skilful in analysing problems as he might have been, had he learned some other way.

That, at least, is the theory behind the language Logo, which Apple has adopted 'because of the widespread use of Apples in education', said the Logo company, Logo Computer Systems Inc.

The deal between Logo and Apple should bring the language to Australian schools, since Apple now has world-wide distribution rights.

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The MicroPro bonus. Like WordStar, CalcStar is packed with innovative features that make it versatile and easy to use. Features like Automatic Forms Mode, which lets an inexperienced user enter data into a spread sheet quickly and with less chance of error.

CalcStar's greatest innovation is its ability to join with WordStar. Which means, for example, you can use WordStar's printing options, like boldface and underlining, to dress up financial documents. And you can insert sections of CalcStar's spread sheets into your WordStar documents.

This kind of flexibility should come as no surprise if you're already familiar with the MicroPro software family – a line of programs designed to work together to multiply your problem-solving power. Call or visit our showroom to find out just how big a difference *all* MicroPro products can make in your business. We predict you'll discover it's not just CalcStar or WordStar that's indispensable. It's MicroPro.

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By Andrew P. Bartorillo

A complete management tool for the home budget, this useful program helps keep track of your income and expenditures and provides an easy method of budget allocation.

MONEY MANAGER answers the question, "Where does it all go?" by categorizing the outgo of your money in accounts that you design according to your needs. It provides a means of keeping complete and accurate records, including an itemization of your tax-deductible expenditures—you can imagine the time savings at tax time alone!

You can store information on up to 100 checkbook entries per month (250 with 48K), specify any automatic withdrawals (such as automatic mortgage payments), keep a separate list of tax-deductibles, and record expenses by category. Checks payable to charge card companies and other lump payments may even be broken up to be placed into the proper individual categories. If you have a lineprinter, MONEY MANAGER will provide formatted printouts by category and time period.

MONEY MANAGER requires a TRS-80* model I or III with a minimum of 32K and one disk drive. Order this time and money saver now for only $49.95.

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EVEREST EXPLORER lets you challenge the world's highest mountain without ever leaving home. You make all the decisions in this logistical simulation.

You select the manpower, food, fuel, shelter and oxygen you need. Then manipulate your resources to outwit the elements and terrain, establishing ever higher encampments. Will you reach Everest's 29,028 foot summit—and return to tell about it? Just $24.95 for model I or III. Order on 16K tape, or the 32K disk version which includes a "save game" feature and other enhancements.

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By John Allen

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Ohio resolution

High resolution colour graphics are now available for home and business computers of the Ohio Scientific kind.

The Ohio C8P-DF floppy disk video system can be hooked up to a colour television set, and provides 16 colours with a resolution of 512 x 256 points. It has been running in business applications for some months.

Optional facilities include dual sided disk drives, high speed processor and memory, voice output synthesiser, remote control security system for home or business, and assorted research and development boards.

Software includes a variety of standard business packages with word processing, inventory, mailing lists, etc. Nine educational disks cover topics from geography to maths to speech therapy. There are ten games disks, each containing seven games, including star wars, golf and etch-a-sketch.

The C8P-DF operates under two operating systems and responds to Basic and machine language.

Contact the TCG Group, Australian distributors for Ohio Scientific, at head office in Sydney on (02) 439 6477, or in Melbourne on (03) 568 6133.

With remorse

Having been caught out overdoing the verbal dramatics in this column, I must mention that there is no need to pressure ANZ Books for a copy of Gletzer's *Introduction to Word Processing*. Those estimable dealers have had it all along. It's available from good Australian bookshops for $17.95 and, if you can't find it, ring ANZ on (02) 452 4411.

Pearls before swine

A new type of application generator, allowing users with no computer experience to describe their requirements visually and in English to a microcomputer, is available from Relational Systems International in the US. It's called Personal PEARL, and evolved from the company's earlier software tools. The original program generators were designed to relieve professional programmers of the repetitive aspects of programming.

Personal PEARL enables the arrangement of information in any way needed, and automatically generates applications according to user requirements.

It retails for $US295 and can be used interchangeably on all micros. RSI can be contacted at 5002 Commercial Street, S.E., Salem, Oregon 97306; Tel: (503) 363 8929.

Mini mini floppy

A new 3 inch compact floppy disk is available from Japan through Delta. Developed by Hitachi and Matsushita, and manufactured by Hitachi Maxell, the format has been standardised by the three companies to help promote wide acceptance and use.

Delta will initially and primarily be distributing the little disks for use with their Hitachi computers, though Shugart pin compatibility makes them suitable for other brands.

The disks are plastic cartridges, about cigarette packet sized, with dust excluding stainless steel shutters which pull back on insertion into the drives. (see pic. below)

Recording format, data transfer rate and rotation speed are the same as existing floppies, providing compatibility with ordinary controllers. Because they also have the same recording capacity, data can be transmitted from the mini to the new compact floppies. A Write Protect mechanism is available. Storage capacity is ½Mb per double density disk. No prices are available at this stage, although it is thought that both drives and disks will be less expensive than normal 5 inch floppy systems now available.

The manufacturers point out, as a feature, that the backbone of the case can be used for titles, but this very thickness also makes them bulky for storage.

According to John Millar, of Delta, the Australian release is two weeks ahead of the Japanese release and three months ahead of the projected US release. He intends to start shipping 500 units a month.

The compact Floppy's size compared with the normal 5 inch disk.

VICissitudes

Continuing its habit of tying the underclothes of its dealers into intricate patterns, Commodore has handed the VIC to Dick Smith to be marketed through his chain of shops. Dick Smith is offering his usual seven-day-money-back-if-you're-not-happy deal, plus the three month warranty, plus your name in a barrel for a Datsun Stanza to be given away in November.

Supplies of the VIC are still not flowing freely. While Commodore dealers were apparently mildly surprised that a dealership went to Dick Smith after protestations to the contrary, the expected volume of sales meant that they didn't actually get paranoid about it. However, the fact that a quarter of the initial shipment of 2,000 went to Dick Smith while the old faithfuls have lots of back orders, I'm told, was mildly worrying.

Commodore is also hassling with a delayed reaction from the state governments on certain standards. The standards apparently are not actually being contravened but, in accordance with the axioms of red tape, the fact that there aren't a number of forms in triplicate testifying to it, has brought a freeze six months after the initial go ahead.

Business contender

Twinlock Australia, with a 15 year history in paper-based systems, has moved into computing with a business system. Based around hardware from Mitsui in Japan, the Twinlock MCS has integrated Australian business software at a very competitive price.

Although developed as a complete business system, Twinlock points out that,

OVER 6,000 SOLD!

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New Model — New Features!

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A brand new model — now with extra value! The first row of 16K RAM is fitted as standard in this unit, with provision for an extra 16K (which gives the System 80/Expansion Unit 48K total memory). And it's $100 cheaper than the previous model! It provides as standard, a floppy disk controller capable of controlling up to 4 single density disk drives. Although the exterior of the unit is similar to the previous model, there are significant changes internally; the Centronics printer port is still standard, but the RS 232C interface and connector are now only available as an option. The S-100 motherboard has been removed, and is available as a second option for those who require S-100 expansion capability.

$100 less than previous model!

Cat. X-4020

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Colour Graphics Cat. X-3275

Now you can have colour with your System 80 computer! This kit gives you 8 different colours AND it has a PAL encoded modulated RF output which allows it to be used with any standard colour TV receiver.

Only experienced hobbyists or technicians should install this kit. $129.00

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Superb dot-matrix printer that uses ordinary fan-fold sprocketed paper up to 204mm wide. Its most unusual feature is the single hammer print-head — this means very few moving parts for increased reliability. Fitted with a standard Centronics type parallel data interface making it compatible with most modern computers. Cat X-3252

WAS $495!

$399

DAISY WHEEL WORD PROCESSOR PRINTER

The Dick Smith Daisy Wheel printer delivers ultra sharp copy which is a definite prerequisite for word processing. It will accept standard office stationery or continuous stationery up to 400mm wide, if required. The cartridge ribbon and economical Diablo fonts are freely available making this a very versatile printer. Cat. X-3265

$1845 WAS $1,995!

ITOH 8300P DOT MATRIX PRINTER

The Itoh 8300P features high speed, bi-directional printing (125 characters per second), with full upper and lower case character set. It accepts standard fan-fold sprocketed paper up to 240mm wide. This means you can do 80, 40 or 132 column printing. Fitted with standard Centronics type parallel port. A great seller with great features. Cat X-3255

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WAS $920!

NEW Full upper and lower case video display capability

NEW Flashing cursor

NEW Screen print facility (obtain a print-out of any 'page' appearing on the screen)

NEW Built-in speaker

NEW Monitor program (suitable for the hobbyist to program in machine language)

Cat. X-4005

and look at this great new software!

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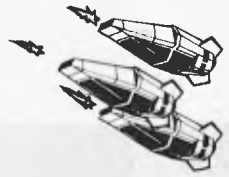
Pit your skills against the killer beetles. You dig traps and when the beetle falls in you bury him. Problem, they don't stay buried! Cassette based, req. 16K.
Cat. X-3598 ***$19.95***

GALAXY INVASION

Real time graphics and sound, the idea is to destroy the invaders and save Earth, but beware of the Flagships!
Cat. X-3693 ***$19.50***



GHOST HUNTER

The aim is to eat the energy dots in the maze before the ghost can get you. Random 'power pills' will assist you in chasing them.
Cassette based, req. 16K.
Cat. X-3597 ***$19.95***

SUPERMAZE

The maze game to end all maze games. It can generate mazes up to 100 x 100 elements — it can take you many hours to find the way out!
Cassette based, req. 16K.
Cat. X-3672 ***$17.95***

DEPTH CHARGE

The latest version of the arcade favourite. Your mission is to destroy the enemy submarine pack. Good graphics and includes sound.
Cassette based, req. 16K.
Cat. X-3686 ***$14.95***

RAIN ANALYZER

A most useful program for the man on the land, the geography student, etc. By keying rain patterns for your area in the past (these figures normally available at your local post office, etc.) you can predict rain fall patterns, volumes, etc.
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TREK 78

The classic computer game based on the ever popular TV series 'Star Trek'. This game utilises good graphics and provides continuous 'status' reports. Your aim is to destroy the enemy and save the Galaxy. Cassette based.
Cat. X-3644 ***$12.95***

New! A high resolution Monitor at a low price!

With this monitor added to your computer system, you'll be able to use it for almost limitless applications: for accounts, statistics, education, medical, amusement and for any purpose data and video display. The anti-glare screen with its jitter and ghost free image makes viewing much easier and sharper and allows 80 characters with 24 lines. A must for the serious computer hobbyist or professional.
Cat. X-1200

$349

Still cheapest per byte!

These superb disk drives cost so much less than the Tandy disk drives and they incorporate a high-quality MPI B51 drive mechanism together with matching inbuilt 240V power supply! Each drive has high storage capacity — 40 tracks and is suitable for both single and double density recording. With double density recording, you can store more than 180K bytes per diskette! The disk drives are suitable for use with most computers and disk controllers using the standard 34-way connection bus — such as the System 80 and TRS-80 (Don't pay their prices for disk storage!)

$419

Drive 0
Cat. X-4060
Drive 1
Cat. X-4061

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The new MCS computer from Twinlock Australia

particularly with the amount of internal RAM, the MCS would be suitable for any kind of professional application and for the serious home user.

The system has 128k of internal memory, which is becoming more common on new machines, and the processor is a Z80. The monitor is a Sanyo 12 inch green screen, with an optional colour model available. A high resolution graphics board is being developed. There are two serial ports and a parallel port; and two disk drives provide storage at 330k per drive.

The machine handles CBasic, Fortran, Pascal and Assembly language, and CP/M is on its way.

Australian written and tested software covers the usual range of business applications. PIPS, for Programming and Information Processing, Simplified, is Twinlock's visicalc-like utility.

The all-up cost is $6250. This covers the CPU/keyboard, 12 inch VDU, and 8 inch printer which works at 150 characters per second, the disk drives and PIPS.

The company promises full training and support for the product.

Twinlock has branches in all the Eastern states, and is using agents in South and Western Australia. Contact head office in Melbourne on (03) 584 4000.

Tasty new HP

A new desktop computer has been announced to sit at the top of Hewlett-Packard's 80 series (which began with the HP-85). Called the HP-87, the machine has a considerably more luxurious spec than the other models and comes well supported with scientific, engineering and management software. (Like the 85, the 87 comes with an integral VDU but of larger size and of an unusual landscape format which can handle 80 character displays. The standard memory is 32k RAM, 16k video RAM and a huge 48k extended Basic in ROM. With its normal coyness over hardware HP does not say what processor is used, but memory can be expanded to 544k by add-on modules. Another add-on module contains a separate Z80 to allow CP/M to be run; Wordstar and DBase II are offered along with graphics, maths, circuit analysis and statistics package for starters. A new uprated Visicalc which can exploit the full memory expansion has also been produced.

The extended Basic is upwardly compatible with the 85 version so that 85 programs can be run, and the enhancements include label addressing and indented program listings. An assembler in ROM will soon be available, too.

Disk storage is on standard HP 5in systems or their new winchester drive which holds 5Mb and has a built in 5in floppy for backup. Communications are catered for by HP-IB, RS232 and the new HP-IL loop.

At $3,595 for the basic computer, the HP-87 sounds uncharacteristically affordable, but the prices of add-on memory and peripherals dispel any vulgar notion that HP is going down-market; the CP/M system costs a bracing $713.50

Announced at the same time is a new desk-top plotter, the 7470, which sells at $2,155.74 and can plot in two colours automatically, or more with manual pen changing.

Guy Kewney

See 'Tasty new HP'.

Honeymoon over?

The honeymoon is ending for Digital Research as users get to grips with the new version of CP/M — the one that runs on modern 16-bit micros like the Intel 8086.

Ironically, the serious doubt comes as Digital Research reaches a publicity peak, with first official news leading out (in the computer trade paper, *Computing*) of CP/M for the extremely powerful Motorola microprocessor, the 68000, expected to be universally used in five years time.

The improved 'Super' version of the operating system proved invaluable in getting programs from old 8-bit systems running CP/M, and transferring them to big new 16-bit ones.

But programming companies writing new code for the modern machines — new programs that take advantage of the enormous data storage and processing power of the chips — are finding CP/M-86 inadequate.

Peachtree, one of the most successful applications writers (the company claims to be the biggest micro application producer in the world) and with a prestige agreement with IBM to write Official IBM Software for the new IBM Personal Computer, is very dubious about its ability to transfer software, even to a machine like the Sirius.

The reason is that the programmers cannot resist the temptation actually to use the power of the machine.

Normally program writers use all the aids that the operating system can give them — to save them the hard work of writing code to fetch data from disks, to read keyboards, to display characters on the screen, or to move blocks around memory.

But the old-fashioned options of CP/M, as carried forward into CP/M-86, are just not powerful enough, according to senior programming staff inside Peachtree. And the result is that programs which 'run under CP/M-86' according to the brochure, actually run according to themselves, and merely load under CP/M protocols and commands.

Normally, a dealer who stocks two ordinary CP/M machines will speak confidently about the task of taking a program which runs on one and transferring it across to the other, using a utility program called PIP (or, if it looks difficult, a more powerful program called BSTAM).

But Peachtree programmers are very dubious about the size of the job facing them in taking programs from the IBM machine (under CP/M-86) and transferring them to the Sirius (and, as yet, unnamed in Australia) even though that has the same processor, obeying the same machine instructions and ostensibly using the same operating system.

They say that there is just too much code written in the base-level language of the machine, which would require programming effort at the level of translate into the alternative version. The version of CP/M for the big Motorola 68000 will have problems that would nor-

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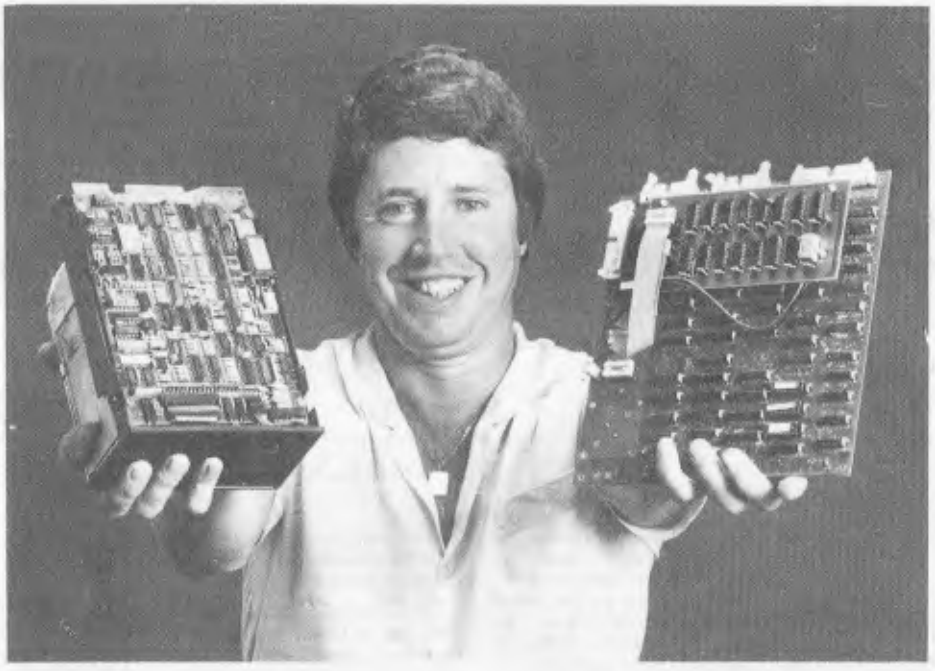

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mally be expected to be unmanageably more difficult — but will merely be the same problem in a different language. The actual instructions will be different but, more to the point, the machine in which the instructions are carried out will be different but, more to the point, the machine on which the instructions are carried out will be different in its layout, its method of handling messages and of storing data.

What is needed is a new operating system, designed for the big-memory and complex-data abilities of the 16-bit microprocessors, which can run CP/M-86 as one of its sub-tasks the way CP/M runs applications.

And, until someone starts developing the tools that systems designers need for a mammoth task like this, we will have to rely on the normal, slow evolution of complex programs — giving us something useful in five to 10 years from now.

Alternatively, we can wait for results from the colossal sums being poured into Japanese research into the problem of providing these tools.

Guy Kewney

Superchip

Hewlett Packard has made another of those announcements whose regularity tend to obscure the ramifications.

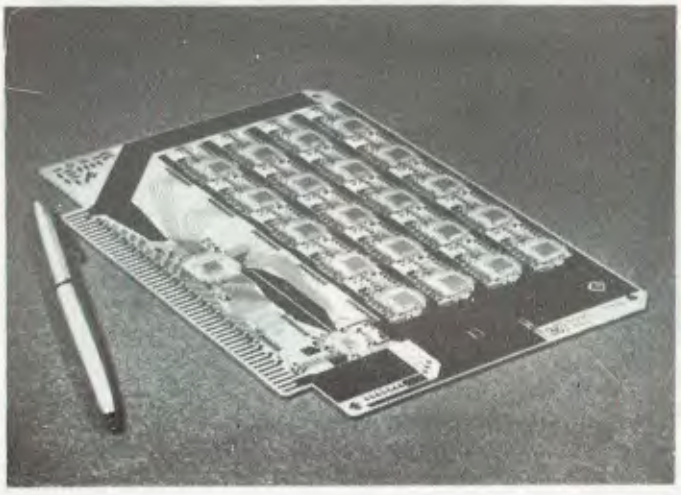
The latest "shrinkage" in computer circuitry comes in the form of a quarter-inch chip containing 660,000 transistors. According to HP, it is three times as densely packed as the commercial circuit designs currently available.

Together with the 450,000-transistor chip finished last year and four other chips, the new memory chip forms a complete 32-bit computer system which HP expects to market in a new product in about a year's time.

Geoff Foley, Systems Engineer with HP Australia's Instrument Group, said that the memory chip holds one and a half times the number of parts in a jumbo jet (an interesting but probably useless comparison) and that it holds the largest amount of circuitry ever successfully built into a single chip.

Only 40 millionths of an inch separates the transistors, and this tight packing speeds the system by reducing the distance that electrical signals must travel.

The system can process 32 bits of information simultaneously, and takes 55 billionths of a second to add two numbers.



Tiny computer chips are bonded to a special copper-core substrate, as shown by this memory subsystem, for higher-performance connections and to aid cooling in a 32-bit processing system being developed by Hewlett-Packard Company.

Last year one Australian company introduced 209 software programmes to Apple personal computer users and we bet you don't even know our name?

A MACHINE FOR ALL SEASONS

Martin Banks speculates on the impact of Commodore's 64.

One of the minor inconveniences of writing for a monthly magazine like *APC* is the time-scale involved in producing the beast. The words you read here were written towards the end of March, yet the mechanics of magazine production dictate that they do not appear until now.

This sometimes makes writing a trifle difficult, for occasionally something happens (or more specifically, looks as though it's about to happen) that is worthy of comment or prognostication at an early stage. By the time the words appear, however, the situation that prompted the prognostication may have changed.

That could well be the case with the first appearance of news about a new machine from dear old Commodore (which has surely been around long enough now to be promoted to Rear Admiral). The machine is called the Commodore 64 and it has been waved around at the Consumer Electronics Show in the USA.

Now the problem is that information on the Commodore 64 — at the time of writing this - is somewhat scant and is likely to stay that way until the Australian launch of the product.

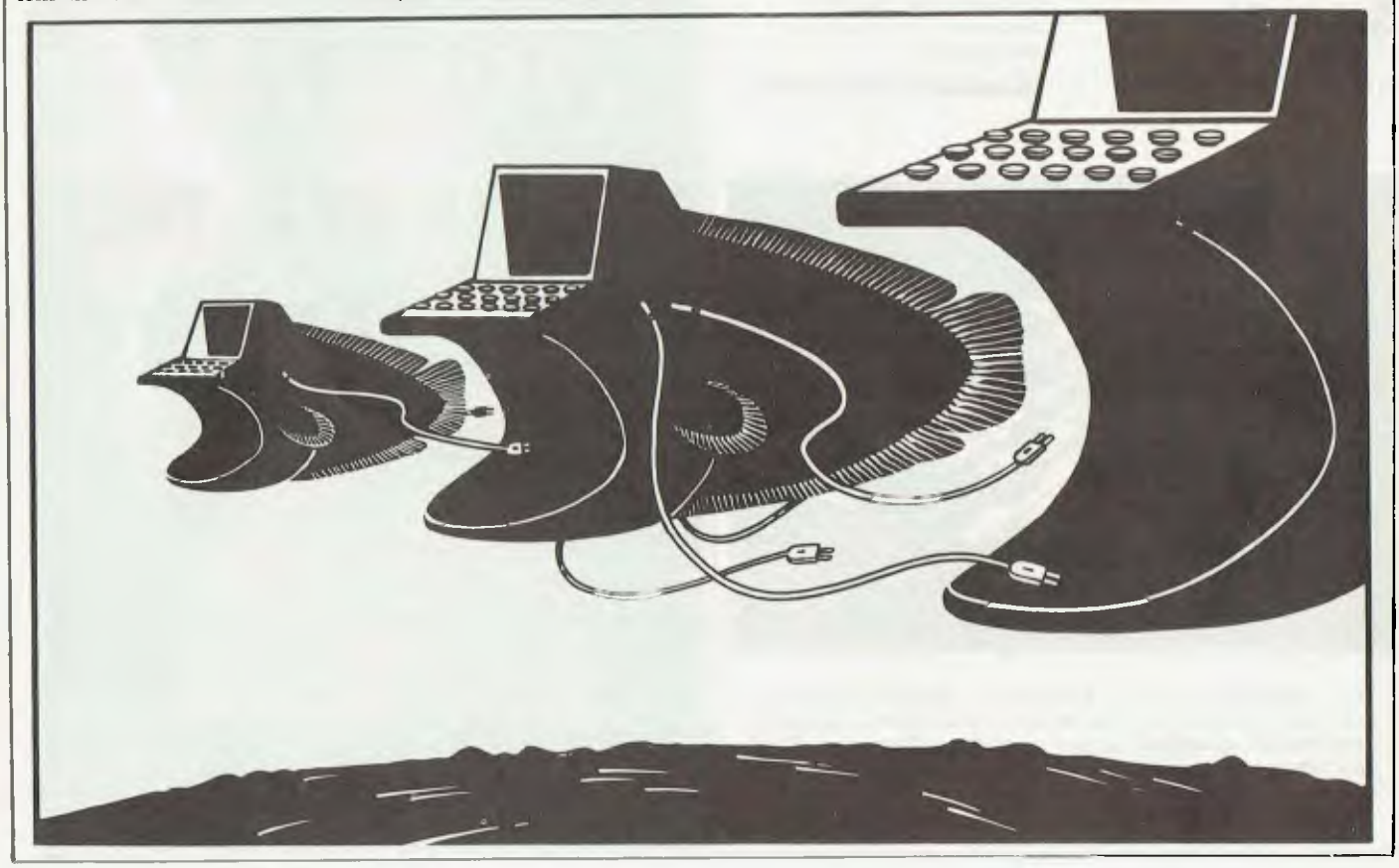
But even that would not be a problem in most normal circumstances, for what information there was available could be ignored until after the event and an article could be prepared then. Indeed, in most normal circumstances that is exactly what would happen. The Commodore 64, however, sounds interesting, both from what the early information suggests the company is trying to achieve and from the viewpoint of the company's products, post Chuck Peddle.

As most readers will by now be aware, the daddy of the Commodore PET, Chuck Peddle, left the company over a year ago to form his own show. That show is Sirius, a company that launched a comprehensive and competitively priced machine at the back end of last year. At the time of that launch, Chuck was questioned about his view of Commodore now he was outside the company. After all, since the PET, the company had come up with little in the way of internally developed new products, Most of the PET add-ons came from the approved-products scheme and even the VIC had strong Japanese ancestry.

His replies were interesting, especially in the light of recent events, 'Commodore management is primarily interested in shifting product,' Peddle said. He followed that with the prophecy that if the company chooses to stay with its predominantly low-end spectrum, it would continue to be around for a while.

Well, recent developments from the company would tend to indicate that it does indeed intend to stay in the low end of the market place. The more long-term developments that the company appears to be making, moreover, will tend to keep it very much in the business of high volume sales — 'shifting product' as Peddle puts it.

The Commodore 64, on the current sparse information, does not sound spectacular, except for two points. One (almost of necessity) is price. In the US it will retail for $595 while providing a performance comparable to an Apple II retailing at around $1650. There is



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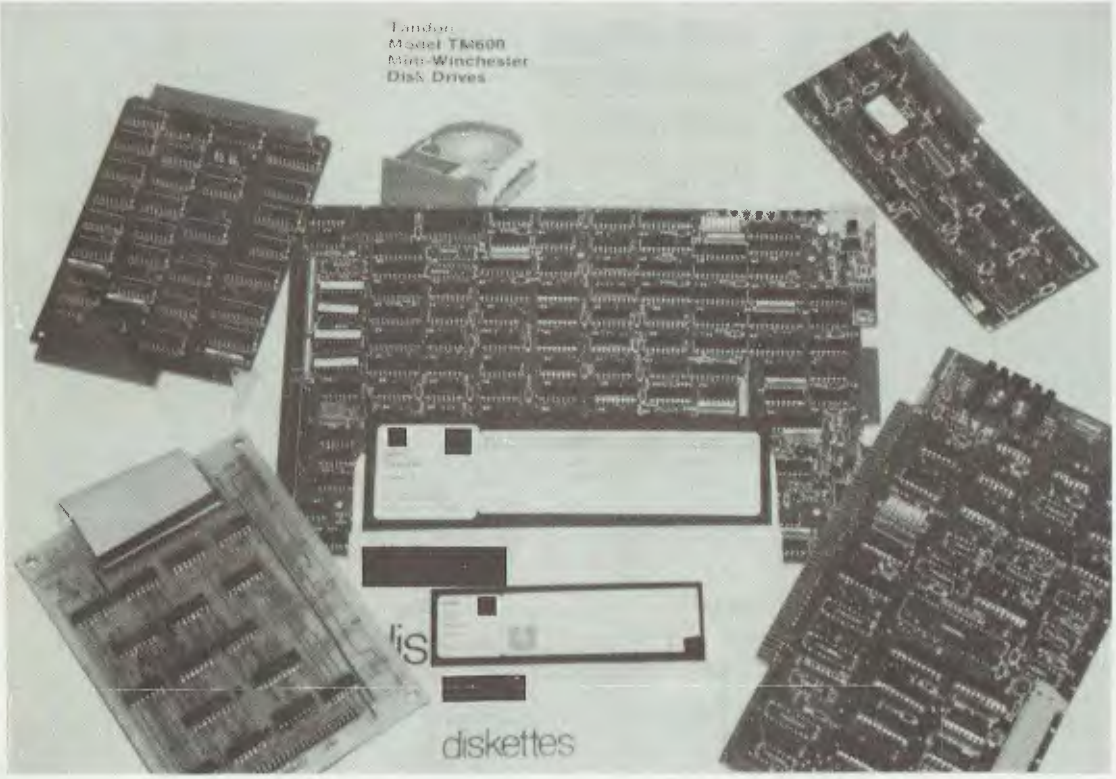

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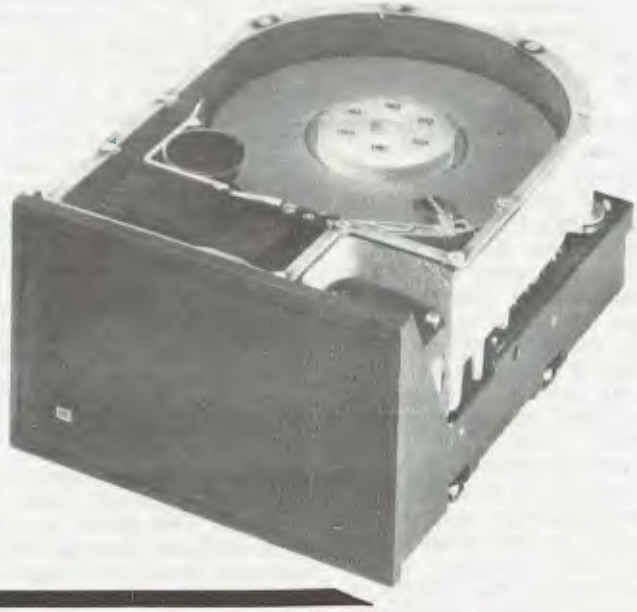

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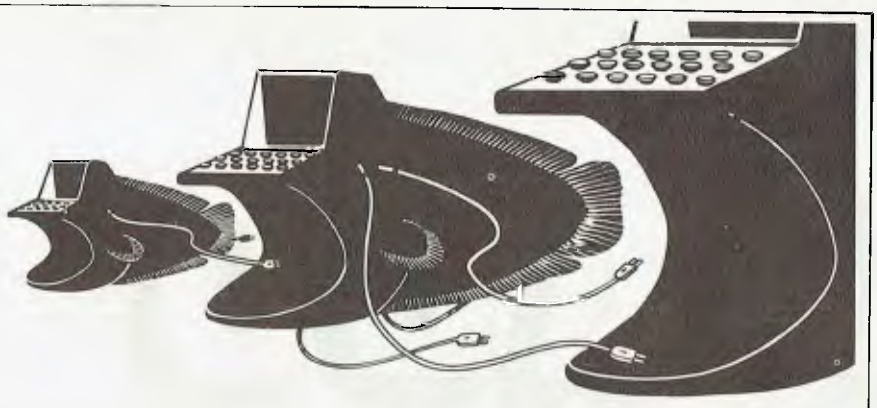

nothing amazing about that, really, for semiconductor technology is always driving down the price of systems, while maintaining their capabilities, or even pushing them up.

The second point is, in its own way, much more interesting and the previously mentioned comparison with the Apple II becomes more relevant, for the Commodore 64 can run Apple software. OK, so the software will have to be entered via the keyboard rather than from disk but Commodore reckons the necessary modifications for that function could be provided at negligible cost.

Why the hell should anyone stop at emulating just one type of system – why not the world?

Such 'negligible cost' means that it would be an easy step for Commodore to strike at the very heart of its great US rival, Apple, and produce a low-cost emulator of the Apple II that ran all the software available for the US market leader and that at a price that could seriously damage Apple financially. It is, for example, interesting to note how, since adopting Apple and others as the star stock market purchases of 1981, American stock analysts have rapidly become 'street-wise' enough to notice this possibility from within the Commodore announcement and bomb Apple's stock price by $2 in a single day.

Commodore apparently says that it has no plans to do that small thing, ever. Instead the company would appear to be after bigger fish. 'Bigger' in this context might sound derogatory towards Apple and as such this is not intended. Rather 'bigger' refers to the whole damned microcomputer business, which now includes some other minor inconsequential companies like IBM.

For Commodore would appear to have latched on to the obvious idea that once you have learned *how* to emulate another type of microcomputer system and found a *way* of achieving the emulation that is both simple and inexpensive, then why the hell should anyone stop at just emulating one type of system? Why not emulate the world — or at least all the relevant bits of it such as Apple, IBM, Tandy, Sharp, NEC or anything else you fancy?

In hardware terms this is now becoming a relatively easy task. Several people in this country have been looking seriously into the possibilities of doing it, and products in this area may well appear in the near future.

The key appears to be the use of gate arrays — that group of microelectronic devices that allows circuit designers to produce economically a whole range of sexy custom-design devices for whatever they want to achieve. The arrays provide a very useful facility for the system designer who wishes to emulate another machine; for there are several ways of doing this trick, and many problems to be overcome. That facility is convenience.

The two main options facing the designer are : a) use bit-slice processors and microcoding to emulate the instruction set of the emulatee; and b) interface the main system processor with the same system processor as the emulatee. The first route is often the more elegant, and one followed by many of the minicomputer manufacturers to emulate their own products. Its major drawback is that microcoding instruction sets is an extremely complex black-art, and is not really feasible for emulating a range of different machines. The second route is better, because the emulatee processor(s) can be mounted on a circuit board, plugged into the main board of the basic system and away you go. Well, in theory anyway, for the two beasts have to be interfaced, and that means a gate array.

There are many subsidiary problems to be overcome after this decision has been made, and the gate array approach has a part to play here as well. The main problem is where different systems — and especially different operating systems — usually expect to find I/O devices, of different types, at different locations. This means interfacing both at the software protocol level and at the hardware device level. Again, this is the the type of application for which gate arrays might have been invented.

It would appear that this is the route that Commodore has selected to follow. The Model 64 would seem to be the basic system for a new range of modular emulators that will almost certainly cover such systems as the Apple II, TRS-80 and the IBM Thingie. It would also appear that, as might be expected, the cost of each emulator will be fairly low — probably around the $1000 mark. Each emulator will be a module that plugs into the back of the Model 64 (or a variant/development of that basic machine). No doubt that machine will also have the capability for considerable memory expansion, for though the Model 64 has 64 kbytes of RAM, it also uses the new MOS technology 6509 processor chip which has on-board memory management that allows up to 256k to be addressed. The processor chip also has on-board RAM, suitable for running a small set of commonly used instructions at high speed. This would be an ideal facility to have for controlling the operation of an add-on emulator board.

Microcomputers ... would become akin to commodity items like a can of beans

As one US stock analyst has already observed, if Commodore actually goes through with what it appears (and is rumoured) to be planning, it could dramatically change the shape of the microcomputer business, for it would have at last brought the hardware side of it down to the level of becoming an irrelevance. Potential users would no longer have to suffer the agonies of choice between rival and incompatible systems — a choice that immediately governs what software can be used.

Microcomputers, or more especially the variety of system emulators, would become akin to commodity items like cans of beans or Intel 8080 processor chips.

Whether this is a good thing for the business in the long term is open to question. The implication of such a move for the hardware companies is that they would all have to follow suit if Commodore's efforts proved successful. Prices would be savaged in an orgy of competition until such time as every potential user in the world was no longer potential — they were actual.

Now if such systems are as reliable as we know microelectronics *can* make them, all of a sudden the manufacturers' market will disappear. For, apart from anything else, such emulators would essentially mean that any user buying the basic box (say at $500) plus Apple, Tandy and IBM emulator cards (at $1000 each) would effectively have *the* universal system from $3500.

The only option open to the manufacturers would be, horror of horrors, built-in obsolescence and failure.

There is, of course, a good side to all this. Any degree of universality in hardware, even if it is only achieved indirectly through emulation modules, will allow software writers the opportunity of forgetting about the problem of which machine to write an application for. It will no longer matter too much — and it will also mean that once a program has been written and debugged, it won't have to be rewritten (and re-debugged) to run on another make of system. Universality of hardware will lead to the universality of software, and, as software is the *real* key to everything in this business, that can be no bad thing.

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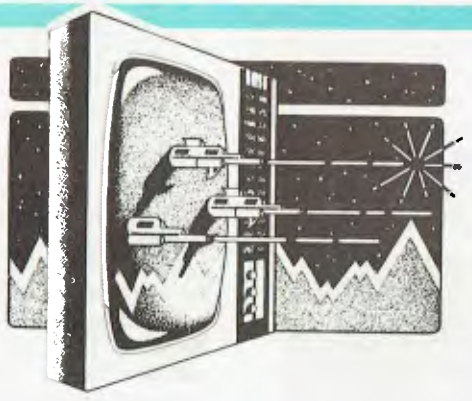
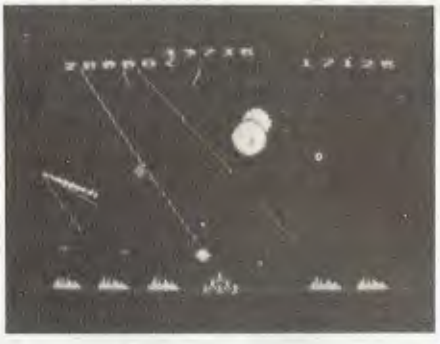


The advances in computer-controlled video games over the past five years or so are breathtaking. A limited number of (mainly textual) computer games had been available to large computer users for many years, but the computing power required prohibited their use by the general public. In the mid-'70s, as the price of components fell and video techniques improved, the first stand-alone video games appeared, seemingly overnight, in arcades and bars throughout the western world. It started with those tennis games, where each player had a flat paddle (sometimes two) with which to return a simple bouncing ball. A slight sophistication of this was the popular 'Breakout', with the ball being used to knock out bricks from a horizontal wall. Then came Space Invaders, which rapidly achieved such notoriety that its name is now often (erroneously) used to describe the entire *genre*.

As Space Invaders and all its descendent forms took over the arcades, the paddle games became available on cheap modules plugging into a domestic TV. For a while, microcomputers could offer only fairly limited textual stuff (like Hangman), but with the advent of cheap graphics they, too, began to run sophisticated and colourful video games. Now the gap between home computers and TV video game modules has started to evaporate and may very soon disappear altogether. After all, if a unit has the power to run complex games programs, why not make that power available to the user?

Over the coming months I shall be looking with a critical eye at the games which home computers have to offer. Although many of the arcade originals like Space Invaders are now available on micros, the arcade games will remain some way ahead of their living room counterparts, if only because it makes sound economic sense for whoever owns the software copyright. For this reason I intend to look also at some of the best of these games.

To begin the series, I have been looking at a wide selection of games for the popular Atari 400, a lightweight home computer designed specifically with games in mind from a well-established leader in this field. The standard 400 carries 16k of RAM and - though it is possible to upgrade this - I have included only those programs which will run on the basic system. Atari ROM packs plug directly into the machine, but for any other games you'll need an Atari 410 cassette recorder. The computer costs $669, with an extra $149 for the recorder and $35.95 for each pair of joysticks (of which at least one is essential), making a total price for the system of around $843.95.



GAME: Missile Command
PRICE: $69.95
SUPPLIER: Atari

This is one of Atari's most popular arcade games. Your task is to protect six cities from waves of missiles which stream down at you from the top of the screen. You are provided with 30 defence missiles which appear six at a time on your launch pad. The joystick controls a small target sight and leaves a detonation mark when the fire button is pressed, towards which your missiles are launched. The trick is to place your detonation marks slightly in front of the approaching missiles so that they reach it at the same time as yours do. The game ends when all your cities have been destroyed, though you get a bonus city for every 10,000 points scored. Things are complicated by bombers flying across the screen dropping deadly bombs and by triangular 'smart missiles' which have the ability to avoid your defence detonations.

In the arcade version of Missile Command, you had three bases, each with separate fire buttons and the loss of this feature makes this game rather less interesting, albeit still highly addictive. Options include one or two players (not simultaneously), skipping any number of attack waves (thus starting at a higher skill level), fighting smart missiles only and nullifying the potential for bonus cities. The graphics are excellent, with the colours changing dramatically as you work through the attack waves.

Games like this often attract criticism on the grounds that they represent glorified reconstructions of real warfare. Generally I dismiss this suggestion by viewing the games as pure fantasy having no significant effect upon peoples' actual political attitudes. The military terminology which Atari uses in the Missile Command manual is, however, extremely disturbing. In the introduction you are told that 'For weeks now satellite surveillance has been sending you photographs showing unusual arms buildup. . . It's only a question of time now before the enemy launches ICBMs targeted for the only remaining free cities of the world.' I'm afraid the situation in contemporary America makes it impossible to take such remarks lightly and I wish that Atari had taken a different approach to what should be an entirely frivolous activity. Conclusion — love the game, hate the politics.

VALUE FOR MONEY: *****
USE OF GRAPHICS: ******
ADDICTIVE QUALITY: *****
RESPONSE SPEED: ****

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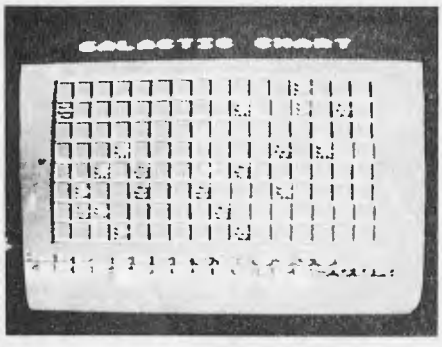
RED ALERT

GAME: Star Raiders
PRICE: $69.95
SUPPLIER: Atari

Just over five years ago, when I was programming PROM's I used to spend many happy hours playing a game called Star Trek on an Intel development system. In those days colour graphics and real time space games were unheard of, so this game was mainly textual (with some primitive charts) but fairly complex and a lot of fun. Star Trek was very popular at that time, though its delights were enjoyed only by those working in the computer industry. Now Atari has taken this grandfather of games, added some impressive graphics and transformed the battles into fast moving extravaganzas to produce one of the best pieces of games software available.

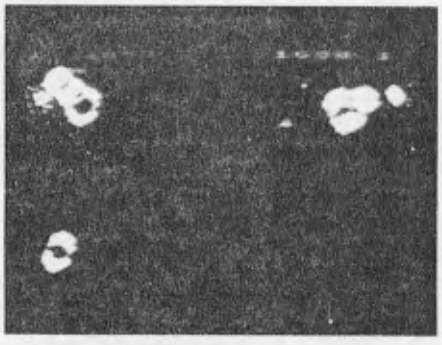


Star Raiders is a one-player game in which your mission is to destroy all enemy craft (Zylon Starships) before they disintegrate your star bases. The galaxy is divided into sectors on an 8 x 16 grid and the positions of all ships and bases are displayed on your galactic chart. You can move your ship between sectors using 'hyperwarp' and within sectors at any one of nine warp speeds, using the joystick to control direction. The ship's 'on board computer' helps track your prey, which you can then destroy with your photon torpedoes. At the touch of the button your screen can be made to display front and rear view as well as a long-range scan and your ship can be fully protected using shields.

At the beginning of each game you have 9999 energy units, which are used up mostly by movement and firing, though other functions also show a small drain. The game finishes when your ship is destroyed or runs out of energy, or if all your bases fall foul of the Zylon. In addition to this, enemy torpedoes can cause damage to any one of your ship's facilities, thus impairing its functioning. Extra energy can be obtained and repairs carried out by docking at one of your star bases. There are four skill levels, described as novice, pilot, warrior and commander, which mainly determine the number and efficiency of the Zylon craft. At novice level you do not need to steer your ship in hyperspace, and no damage can be inflicted on your ship (though it will be destroyed if you are hit with shields down).

This game has become almost synonymous with the Atari 400, and deservedly so. The graphics, sound effects and playing functions are all immaculate and combine to produce an intriguing and worthwhile game. If you're on the point of buying an Atari, I would thoroughly recommend that you include Star Raiders in your budget.

VALUE FOR MONEY: *****
USE OF GRAPHICS: ******
PRESENTATION: *****
ADDICTIVE QUALITY: ******



GAME: Asteroids
PRICE: $69.95
SUPPLIER: Atari

Asteroids has proved immensely popular in the arcades and, since Atari holds the copyright, this is just like the original. Just in case there's anybody left who hasn't seen it, the game involves eliminating waves of approaching asteroids and the occasional mindless flying saucer by firing missiles from a small triangular spaceship. Moving the joystick right or left rotates the ship clockwise or anticlockwise respectively, and forward gives acceleration (thrust). You can fire continuously, but only four missiles can be on the screen at any one time. Medium and large asteroids break into two when hit, while the smallest disappear altogether (and yield the most points). Up to four players can take part (assuming you have enough joysticks) and you get various options as to whether players can shoot each other and when the game actually ends. In addition, each ship can choose from any one of three special defences, activated by pulling the joystick towards you. These include impenetrable shields, hyperspace warp (disappearing for a few seconds and moving to an alternative random position on the screen) and 'flip over' (instantly turning your ship through 180°).

Asteroids combines crisp graphics and excellent response time in an exciting and addictive game. If you're into fast-moving space games this is a classic, though perhaps a little dull beside some of the recent games of its genre. It is, however, rather pricey (possibly due to the obscenely large packaging that Atari insists upon, literally 10 times the size of the cartridge it contains).

VALUE FOR MONEY: ***
USE OF GRAPHICS: *****
RESPONSE SPEED: ******
ADDICTIVE QUALITY: *****

General conclusion

The Atari 400 is an excellent games machine with a very large selection of software, of which I have covered only a small portion. Reading cassettes into the machine can be irritating, especially as some suppliers make the lead tape too long, forcing you to search for the beginning of the data on a standard audio cassette player or by trial and error. At present only Atari supplies ROM packs, though I gather Thorn EMI may be producing these soon. The number of Atari software suppliers involves an extensive and varied stock of games which cannot fail to satisfy all tastes. One drawback, however, is the price, which at present is rather too high, though I suspect that Atari (or Futuretronics, the Australian distributors) will soon be forced to review its pricing structure in this country in the face of increasing competition.

=ARCADE ACE=

Inevitably the arcade game I have chosen to kick off with is my personal favourite; the complex 'Defender'. Generally, I begin to lose interest in games soon after my score ceases to improve (though I'm not sure which way this relationship works), but I've found 'Defender' an inexhaustible source of amusement. The playing object looks like a jet fighter and moves both horizontally and vertically. Vertical movement is controlled by a simple two-way joystick, and horizontal movement via a 'thrust button'. There is also a reverse button which turns the craft round, so you really do have complete control over it. At the bottom of the screen there is an outline of mountains, presumably representing the surface of a planet, but this does not restrict your movement.

The main screen shows only a section of the action and this is complemented by a small scan screen at the top showing the entire playing area. There are ten humanoids scattered around the planet's surface, and your main task is to prevent these being kidnapped by yellow splodges called 'Landers'. The fire button gives a rapid and continuous

beam from the front of your craft and to supplement this you are also supplied with a limited number of 'smart bombs', which kill all aliens on the main screen. The landers try pick up the humanoids and carry them to the top of the screen. If successful, they turn into 'mutants' which give you a lot of trouble. If you shoot a lander while it is attempting this, you can pick up the humanoid and deposit it back on the planet, for which you gain 1000 points. When all the aliens have been destroyed you are given a bonus for remaining humanoids and a fresh attack wave begins.

In the second and subsequent attack waves a varied selection of aliens is thrown against you. 'Bombers' are little purple squares pursuing a kind of sine wave course in packs of three or more and leaving deadly mines in their wake (luckily these mines are only active for a limited period). 'Pods' are little glistening orbs which, when hit, release a random number of 'swarmers'. The swarmers, as their name suggests, tend to stick together, and are like fast moving orange pips. If you take too long over an attack wave, then 'baiters' appear; they look like little flying saucers and are very difficult to shoot down. I should add that all of these except pods and bombers are constantly firing missiles at you.

If all your humanoids are destroyed (either by landers or your shooting them by mistake) then the planet surface disappears and all landers turn into mutants which mount a concerted and sustained attack on your craft. You start with three ships and three smart bombs and get an extra one of each for every 10,000 points. This means that the game could, theoretically, go on for ever; but in practice the real experts seem to knock up a maximum of around 250,000.

The positioning of the various controls can vary, but usually your left hand controls the joystick and reverse button, whilst your right hand is responsible for the thrust, fire and smart bomb buttons. One other feature is a hyperspace button which randomly transports your ship to a new position in the playing area. This is fairly hazardous and — partly because the button is out of reach of both hands — I have yet to integrate this function into my game, though many people use it reasonably effectively in cases of extreme panic.

The graphics and sound effects are superb, but the real joy of this game is the extensive control which you have over your ship. The incredibly rapid responses of the machine make for a fast-moving and exciting battle, and the varied nature of the aliens and their modes of attack call for complex tactical manoeuvres. The only drawback to all this is that it takes some time (and a very large number of forty cents) before you really play a satisfying game. I look forward to the time when games of this speed and quality are available on home units.

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OSBORNE in AUSTRALIA

by GRAEME DOMM

Adam Osborne is not a man concerned with diplomatic niceties. Not content with developing his own unusual micro-computer and undercutting better known rivals in the US, he has made a point of denigrating competitors' products.

Apple, Tandy and other market leaders have borne the brunt of Dr Osborne's criticism of existing micros. Not surprisingly, Dr Osborne exempts his own product from such criticism, saying there is nothing "remotely competitive" against his new Osborne 1 micro.

The modest doctor visited Australia last month to work out arrangements for distribution of the Osborne 1 in Australia. During a busy round of talks, he took time out to discuss the Australian micro market with *APC*.

"It's a pretty vibrant economy here," he said, adding that the Australian market was "not really" different in other respects from overseas markets.

Asked why he had not tackled the Australian market before, Dr Osborne replied – simply – that he did not have the machines to offer before.

"If you want to be an entrepreneur you have to be like a good actor."

He said the Osborne 1 would sell for about $2200, without a printer. Considering its features, Dr Osborne said this was excellent value. Asked about criticism of the Osborne 1's small screen size, he had a ready answer: "Anyone who has read a newspaper should have no trouble with our screen." A larger screen was available as a separate unit, but "only about 25 per cent" of customers wanted this.

Following some confusion about who would be selling the Osborne 1 in Australia, Dr Osborne explained that President Computers in Sydney would be selling to the office equipment market, while Computerland would be selling to general users. The Osborne corporation planned to set up an Australian division to service the distributors.

"We consider the Australian market critically important."

"We don't want 10 guys all on the street selling our product. We want an orderly market," Dr Osborne explained. Using Australia as a base, Dr Osborne said he expected to be distributing to New Zealand, Indonesia and possibly Thailand by July.

"We consider the Australian market critically important to us," he said.

In countries where the Osborne name is well known, like the US and Britain, the unit is marketed strongly under the Osborne brand. In countries like Australia, where Adam Osborne is known less, the names of distributors are highlighted.

The reason for Dr Osborne's fame is two-fold: a book he wrote on microcomputing back in 1975, when the subject was barely known, and a column he wrote for some time in Interface Age, a leading micro magazine in America. In his column, Dr Osborne gave annual awards to products or developments he considered promising. In 1977 he gave his award to a newly developed operating system called CP/M. In 1978 he gave his award to an obscure gentleman from an obscure company calling itself Apple. In 1979 Dr Osborne gave his award to a product called Visicalc. Dr Osborne has been unerringly accurate in his predictions for success of products. Whether he will be so accurate with his predictions for the success of the Osborne 1 remains to be seen.

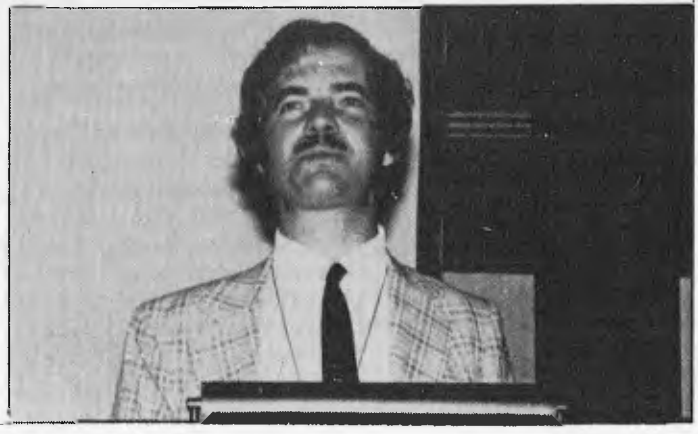
Dr Osborne is originally from Britain, but emigrated to America after graduating in chemical engineering. He gained a Ph.D in chemical engineering at Delaware University, before working at Shell for some years. Dr Osborne left Shell to take up independent consulting, during which time he developed an interest in the fledgling microcomputer industry.

In 1975 he wrote An Introduction to Microcomputers, which exceeded his wildest expectations in sales. From then on, microcomputing was the way to go.

He formed his own book publishing company, which he later sold to McGraw Hill. In 1980 Dr Osborne decided to develop his own micro to cover an area of the market he considered profitable, and in which he believed nobody else was working. The result is the Osborne 1.

Did Dr Osborne ever wonder if his confidence was excessive?

His response was quick: "If you want to be an entrepreneur you have to be like a good actor. You can't be worried about whether you can act. You can afford to make some mistakes, but we have had spectacular growth."



OSBORNE 01

When we heard that Adam Osborne was in town and that he had his Osborne 1 computer with him we tracked him down and, hearing that we were prepared to work all night and most of the next day on the evaluation, he kindly handed it over. David Tebbutt takes up the tale.

Well, after years of telling everyone else what to do and handing out White Elephant Awards to those who satisfied his idea of what is excellent in the microcomputer industry, Adam Osborne has put his neck on the block and come up with an interesting hardware/software package which, with typical modesty, he calls the Osborne 1. It is a portable microcomputer comprising a keyboard, a built-in video monitor, two floppy disk drives and a whole bunch of useful software. In fact, in America, the cost of the software if purchased separately would be around $1500. The Osborne 1 including all this software sells over there for $1795, a theoretical hardware cost of just $295! Nor is the software gratuitous rubbish — it comprises CP/M, MBasic, CBasic, Wordstar, Mailmerge and Supercalc. CP/M is just about the industry standard operating system, which means that a wide range of existing and new software products will be quickly made available for the Osborne 1. MBasic and CBasic must be the most widely used Basic implementations; one is interpreted, the other compiled. At the risk of oversimplification, this means that MBasic is easier to use whereas CBasic programs run faster. Wordstar must be one of the best word processing packages around, although my personal preference (bias?) is for Spellbinder, and it comes with Mailmerge, which enables you to maintain and use mailing lists and merge details from the lists into standard letters and the like. Finally, Supercalc is what the Americans would call an electronic spreadsheet. It allows you to enter numbers, formulae or descriptions on a large matrix of rows and columns. Any cell on the grid whose value is derived from other values within the grid displays a fresh result every time that one of its component values is changed. It is similar to Visicalc but, according to people who've used both, it's also better.

So there you have it; at $Aust2,200 the Osborne 1 appears to be the answer to every would-be computerist's prayer. It does have one major drawback though — the screen is *very* small — 5in — and that's its *diagonal* measure-

OSBORNE 01

The keyboard detaches completely — apart from the ribbon cable, of course.

ment! To overcome this, those who really need one can buy a separate 12in monitor. In America this costs $250. Of course the machine is then less convenient to carry around. Perhaps the answer is to have the large screen situated wherever you use the machine most.

Adam Osborne neither makes nor sells the Osborne 1. He assembles it and tests it from supplied components and he puts most of the selling emphasis on the software available. In other words he's selling solutions to problems and he couples this with the sinister suggestion that you won't be able to compete in your profession without an Osborne 1. Of course such comments apply to all computers, but to read the sales literature you'd think that the Osborne was the only route to salvation. He even claims that the Osborne 1 marks the advent of the Personal Business Computer. If that's the case, I wonder how he would describe machines like the SuperBrain and Apple.

The Osborne is now available in Australia from several distributors in most capital cities. Adam is only authorising dealers who can demonstrate a willingness and ability to support their customers. This means that you're unlikely to find these machines in discount stores or with flaky dealers.

Hardware

The Osborne 1 comes in a cream vacuum-formed plastic case with a carrying handle at the back and a keyboard clipped on the front. A groove runs along each side of the case rather like that along the side of some Rover cars. Unlike the cars, this groove makes the Osborne easy to pick up. It's a bit of an odd shape when the keyboard is clamped in place. In fact when you stand it on end the whole thing tilts alarmingly due to the fact that the keyboard unit is designed to slope down towards the user. Although the present case is vacuum-formed, there are plans afoot for a new design using injection-moulded plastic foam. I'll be mentioning that later in the review.

When the machine is opened, you find a black bezel (front) and a grey keyboard set in a black keyplate. The

The O-1 in carrying mode.

machine weighs in at 26.5lbs according to my bathroom scales but Adam tells me it should weigh 24. If he's right then my scales are wrong and I'm actually my ideal weight. *(Hysterical laughter — Ed.)* With the keyboard clipped in place the effect is not unlike my wife's sewing machine except of course the O-1 is much lighter.

A disk drive is located on either side of the small 5in monitor and beneath each drive is a pocket capable of holding up to 15 disks. I had a nasty moment during the review when I thought I'd lost all the disks. I searched high and low for them and after 10 minutes of sheer panic I glanced at the machine and there they were, nicely tucked up in one of the pockets!

Along the bezel and below the monitor and disk pockets are a number of sockets and controls. Working from right to left this is what you'll find: battery socket, reset button, external video socket, contrast and brightness controls, keyboard socket, IEEE-488/Centronic parallel socket (software switchable), serial RS232C socket and a modem socket. I quite like the idea of being able to see what you've got plugged into the machine without having to grovel round the back. Quite how it looks when all the various leads are in place I can't imagine. The keyboard lead is a flat cable enclosed in a plastic braid. I presume this is to prevent the wires getting pinched when the keyboard is clamped on the front. I didn't have anything connected anywhere else. The brightness and contrast controls I found essential for getting the display just right; unless it is right it can be very tiring to use. The reset button wipes out the memory and returns you to a monitor command telling you to insert a disk and type RETURN. This then drops you into a master menu or CP/M, depending which disk you've loaded.

The review machine had almost silent Siemens' disk drives. They worked perfectly and I could only really hear them when the house went quiet in the early hours. Around three o'clock in the morning I thought I heard a budgie hopping around — it was the disk drives. I decided that I'd had enough and grabbed a couple of hours' sleep. MPI drives are installed on some Osbornes and these are just as reliable — the doors are slightly more robust but, according to Osborne they sound like 'a sack of marbles'!

The screen is interesting because it allows two display intensities plus optional underlining. If you're technical you might be wondering how Adam manages this with just eight bits per character. The answer is that he doesn't — he uses nine for the characters to be displayed. Bits 0-6 are used for the ASCII code, bit 7 for underline and bit 8 for intensity. The matrix is an unusual 8 x 10 which gives true descenders, 32 graphics characters plus the underlining mentioned just now. Another fascinating feature of the display is the lateral and vertical scrolling. The vertical didn't work on the review machine, incidentally, so I don't know whether it would be smooth or not. One thing's certain, the lateral scrolling was perfectly smooth. The screen can display 24 lines of 52 characters at a time. The screen memory can hold 32 lines of 128 characters so, using certain control keys, you can move the 'window' to any part of the screen memory. If, for example, you had completely filled the screen memory and you decided to scroll sideways, the effect would be rather like watching a cylinder revolving, because the whole screen scrolls, not just the current line.

The major disadvantage of the screen is that it's too darned small. Adam tells me that he uses it for hours on end without any trouble, though I did ask Adam if he'd considered putting a fresnel lens in front of the screen. He had, and the result was so much distortion that he felt it better to forget it. Here's a money-spinning opportunity for someone — invent a device that fits into one of the diskette pockets when not in use and which magnifies the screen without unacceptable distortion. Of course, if you'd like to make me rich too for tipping you off then that's just fine by me!

The keyboard is nicely laid out, with both typewriter and calculator-

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OSBORNE 01

style keypads. A few things are on the Osborne that you perhaps wouldn't expect on a budget machine — a caps lock and a pimple on the 5 on the numeric keypad so you know where you are without looking. The keys automatically repeat after being laid down for a second or so. My only criticism of the layout is that you need two hands to scroll the screen — one to hold the control key and the other to operate the 'arrow' key. I mentioned this to Adam and he told me that he was faced with the choice of giving the user single-handed cursor movement when creating text or single-handed operation when scrolling (reading) text. At least Adam's way means you can keep your place on an input document with one hand while operating the cursor controls with the other. I wish I'd thought of asking him why the control key wasn't placed next to the arrow keys. Another way of scrolling the screen is to use the control key in conjunction with the 1, 2 or 3 keys. CTRL-1 displays columns 1 to 52, CTRL-2 columns 53 to 104 and CTRL-3 columns 105 back round to 28.

Moving round the back, there's a little recess which contains the on/off switch and a circuit breaker reset button. This is where you stow the cable and plug when carting the machine around. A plastic cover is 'velcroed' over the recess to hold everything in place. Also at the back is the quaintest carrying handle you'd ever see. It's like those leather handles you get on the old-fashioned cardboard suitcases. Adam is a firm believer that if something does a job adequately then that's just fine. To risk boring you with another quote, he says 'Better is the enemy of good, adequacy is sufficient and everything else is irrelevant'. This maybe explains the 5in screen too and it certainly explains his approach to software authorisation, which you'll be reading about later on.

To get inside the machine it is necessary to remove the bezel, which is attached by four screws, and the brightness and contrast knobs. The screws were easy but the knobs needed a very small Allen key. Once inside, you can only see the first inch or two of the various components since they all disappear into the depths of the case. I felt as if I was peering into a rather full bucket. What I could see looked clean and well made. The only noticeable thing out of place was a jumper wire from one part of the single board computer to another. Adam tells me that there were design faults on some of the earlier boards and that this must have been one of them. The front edge of the board contained all the ports and controls mentioned earlier. Ah yes, that reminds me, the serial port connection should have protruded from the bezel. As it was on the review machine it would have been difficult to attach a printer connector, for example. Once again Adam says that is being attended to. A closer examination would have involved a lot of time literally pulling the machine apart and, really, it just wasn't worth it. I had a peek inside the keyboard unit and it, too, was well made, comprising a metal keyplate in a vacuum-formed plastic shell. The keyboard itself was quite firm and I noticed that a couple of metal channels ran from end to end underneath. I presume that these were attached for rigidity.

Everything connected with the Osborne 1 has got 'Osborne' plastered all over it, even the disk sleeves. I'm not sure whether this is simply sound publicity or an ego trip by Adam. I must say I find the private man far more pleasant than the public version.

Each disk can hold up to 102,400 bytes of information. That's the equivalent of about three times the length of this Benchtest. The disks are soft sectored with 40 tracks, each comprising 10 sectors. A sector on this machine is 256 bytes. I suspect there must be some sort of software fudge to make CP/M think that the tracks are 20 sectors of 128 bytes. Adam tells me that double-density drives will be available soon, which must be good news for those with high volumes of data to process. Although Adam gets his disks from several sources, he tells me that Dysan is the major supplier. Since I use them exclusively, I was pleased to hear this. I have heard that the oxide coating is less stable on some other disks, the 'no-name' ones being the worst offenders.

Software

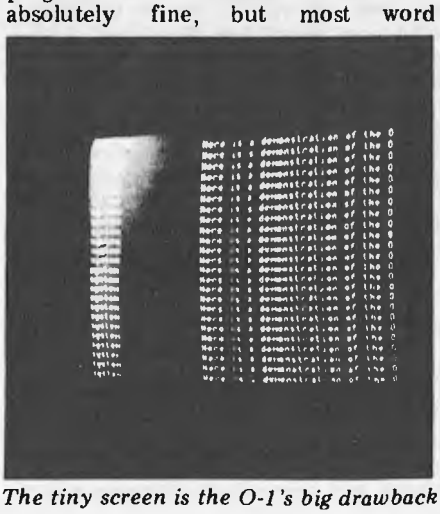
Adam Osborne has collected together a very good range of software which he supplies with the machine at no extra cost. This is sometimes referred to in the trade as 'bundled' software. Adam knew what the most popular applications were and he knew that it would be wise to stick to industry standard system software so he went ahead and wrapped up an entire package which would satisfy most people's immediate requirements and still give them the opportunity to buy other programs as their needs developed. In my view a decent database package would have rounded everything off just nicely but Adam is sticking to a few 'authorised' databases for which the customer pays extra.

Let's comment on each piece of software in turn. If you're an old hand at this game, you'll be able to skip the next four paragraphs without losing too much information.

First of all, CP/M: the name is on everyone's lips, but how many people actually know what it is? The initials stand for Control Program for Microprocessors and it was designed to facilitate the writing of programs for Z80, 8080 and 8085 processors. Although the processors in different microcomputers are the same, the bits and pieces that surround them are very different. Keyboards use different keys, printers vary, screens have different layouts, disks come in an alarming number of shapes and sizes and I/O ports have different addresses. CP/M comes between the program and these different devices and it handles transfers of information between them and the memory. Since CP/M takes care of the information transfer beyond the program and the memory, all the program has to do is to pass the information to CP/M together with some instruction on what it wants done with it. The program then just sits back and waits for CP/M to tell it that the job's been done. This all means that a program written for use with CP/M rather than for a specific machine will be widely used, provided it's worth using in the first place. All that has to be done to ensure that this will happen is that the machine supplier usually 'configures' CP/M to suit the peculiarities of your piece of equipment. By providing CP/M with the Osborne, a whole world of software opens up immediately.

You also get a few other things with CP/M. You get a whole pile of disk utilities which enable you to format, examine, copy, and generally mess around with information on your disks. The most common uses are to initialise new disks — this means writing the tracks and sectors on them and encoding a certain amount of control information for use by CP/M — and to make back-up copies of files so that you can recover from spilling beer on your master disk, for example. Another useful facility allows you to find out how much space is left on a disk. CP/M is often called an operating system and there are lots of manufacturers around who claim that their operating system is better than CP/M. Better they may be, but the fact is that on 8-bit machines, CP/M is the *de facto* standard and you'd be wise to check the availability of the packages you need before going for a different operating system.

And I've not finished yet. CP/M also includes a couple of programs of great interest to keen programmers, or programmers who want to make their programs run faster. The programs provided are an editor (ED), an assembler (ASM) and a debugging tool (DDT). The editor is an absolute dog and should only be used if you have to create programs in assembler language prior to assembling them into machine code using the assembler. ASM checks your program as it tries to translate it into machine code and if it finds anything wrong it tells you so. It can't detect errors in your program design, only in your coding. Finally, if your program doesn't work as planned then you can use the Dynamic Debugging Tool to examine the contents of various parts of memory and the registers as you step through the program. The assembler and DDT are absolutely fine, but most word



The tiny screen is the O-1's big drawback.

processing packages will allow you to edit program files a darned sight more easily than using ED.

Sticking with system software for the moment, you get CBasic and MBasic with the O-1. There are pretty much the same language except that you can execute one as soon as you've finished typing the program and, if it doesn't work, quickly amend it and have another go. The current buzz-phrase for this approach is 'quick and dirty'. If you write a Basic program using the other version then you have to compile the program using a Basic compiler. This takes longer and you can't really change the code generated by the compiler. You have to go back to your Basic code, change that and then recompile the program. The compilation process is similar to, but not the same as, the assembly process mentioned earlier. Why, you might ask, should you go to all that trouble? The answer is that the resulting program will run faster than an interpreted version and you can also embed identifying information which could trap a copyist because (s)he is most unlikely to find it. I ran the Benchmark programs on MBasic (interpreted) and they were faster than most machines we've tested. CBasic of course would have been faster still. Don't get too excited by these findings unless you are heavily into number crunching. The fact is that, in normal processing, the speed of the machine is completely nullified by the enormous time it takes for the operator to respond to the machine's promptings.

There is another tiny system program tucked in the disk which allows you to enter certain constants from time to time. The first is the speed at which you set the serial port — 300 or 1200 baud. The second allows you to change the screen size — 52, 128 or user-defined. The third allows you to enter the date and time. The time is accurate to within a few minutes per day.

That's taken care of the system programs provided, now let's look at the application programs. First of all, Wordstar and Mailmerge. Wordstar is one of the best word processing packages on the market. On the Osborne it is a little strange to use, mainly because of the small screen — see my earlier comments. Adam has wisely had the package modified so that it automatically scrolls sideways as you are typing text in. He has yet to do that with the Basic packages but he promises me that he will. If you're unfamiliar with word processing there's not a lot I can say here except that it will either increase your throughput of typed material or it will improve the quality of what you write, simply because it is so easy to 'craft' your words until you get them right. If you really want to get into word processing, I suggest you read the April 1981 APC where we ran an introductory article on the subject.

Associated with most of the good word processors is a mailing list facility which enables you to create and maintain a mailing list. Wordstar is no exception to this and it allows you to incorporate names and addresses in documents and letters so that they look as if they were prepared especially for the person receiving them. Lists can be sorted and names and addresses extracted according to your own chosen criteria. This is all done using the Mailmerge facilities.

Finally we come to Supercalc. You've probably heard of Visicalc, which is one of the biggest-selling microcomputer packages. Well, Adam couldn't get hold of Visicalc for the Osborne 1 so he decided to plump for Supercalc instead. The program makes good use of the O-1's 'shadow' mode, in which the screen characters can be displayed at half intensity. The spreadsheet grid is displayed in shadow while the entries are all in full intensity. It looks very good. Anyone who messes around with 'what-if' calculations will find this product an absolute boon. Also, are you one of those people who makes lots of calculations and at the end you realise that somewhere, way back, you'd got something wrong which messed up every figure derived since? Using Supercalc, you don't have to worry, you just change the offending number and all the others come right instantly. An interesting bonus is that the data file generated by Supercalc can be edited using Wordstar. I'm sure that's useful but I'm not too sure how useful.

Now on to the ones you pay money for. I mentioned earlier that a database would be my next choice of product. Well, Adam thinks it important too and he recommends three: DBMS, Condor and Datastar. Condor and Datastar are on his approved software list which means that Osborne will be packaging and selling them. DBMS you will have to get direct from your supplier.

Talking of Osborne-approved products, the company will be maintaining three lists: one for the USA, one for the UK and Australia, and an international one. If you're a software writer and you think you'd like to get your product on to the Osborne 1 then Adam would like to receive your documentation first; then, if he approves, you send him four disks with the program on. It will be carefully examined and any comments made. You will then have to bring it up to the required standard and Osborne will then take over the entire production and marketing effort for the Osborne 1 version. You just sit back and wait for the royalty cheques to drop through the letterbox. Adam tells me that the royalties start high and reduce as sales increase. His justification for this approach is that the higher the sales the more it is due to the efforts of the Osborne Corporation. In general, Adam is not too interested in 'better' versions of what he's already selling because, apart from anything else, it dissipates the marketing effort and, if the first one was adequate for the job, is it really worth the extra hassle? I'm not sure how he equates that attitude with the fact that he'll be handling two database packages, unless they're very different.

I used almost all of the programs supplied and most of them worked for the limited time I could try them. I did run into trouble once or twice when I keyed something in; it was echoed on the screen but then the most odd things occurred. The only example that I reproduced was that I'd get into MBasic, type AUTO in order to get automatic line numbering and it would give me SYNTAX ERROR. I'd try for the third time and it would do what it should have done all along and type 10 on the screen. The problem may be in the MBasic implementation or, more likely, I'd got myself a hardware fault. Adam did say that there were a few problems with the review machine's keyboard. Another problem I had, and this time I think it was the MBasic, was that I couldn't read programs which I'd previously saved using the 'A' suffix. It behaved as if I'd saved a null file. Even CP/M's TYPE command couldn't throw any light on this one. Adam thought I must have had a duff version of the software.

Documentation is of good quality.

Documentation

Since Adam Osborne started to make his way in the world with books, you should expect a high standard of documentation. And indeed the manuals are very well presented. Unfortunately the almost obligatory glitches had appeared in the books he supplied me. I don't think I encountered a really serious error — they were things like leaving out the key symbols when describing the various key functions or saying that k=1024 then claiming that the disks were 102k — they're not, they're 100k. When I pointed this out, Adam told me that 'all the manuals are undergoing scrutiny and finalisation right now'. All the books will be in a large paperback format with a glossy cover and very neat, readable typesetting inside. True to form, Adam couldn't resist the occasional homily which I found very refreshing. On the first page of his Users Reference Guide he talked about the incompatibility of the various machines on the market. He then goes on in brackets — well he printed the first bracket anyway — 'This is a deliberate marketing strategy on the part of the manufacturers. It is designed to prevent you shopping around for programs, accessories or additional computers once you've made an initial commitment to one of these products.' Later on he mentions the CP/M editor that I dislike so much 'This editor is primitive and should not be used. Wordstar is capable of perfor-

OSBORNE 01

ming the same task and is easier to use. If you really must use the editor, consult one of the books now available on CP/M.' Dead right.

Adam has tried very hard to pitch the documentation at the first-time user. In one place he gave the very sensible advice, 'Do not try to get the plastic disk out of the cardboard envelope or you will destroy the disk'. Don't laugh, I've heard of people doing it. Here's another one: 'The door on the drive is closed and opened in the same way as you would open and close an overhead garage door.' Isn't that nice? He's actually remembered his most likely audience, the person who's never used a machine before.

Every package is fully documented, sometimes in the User Reference Guide, otherwise in its own separate manual. The only thing that was missing that interested me was a full technical specification of the Osborne 1. You don't need it to use the machine but it would be of interest to the curious, or to Benchtesters like me. The CP/M overview section of the User Reference book is clearer than most books on the subject although it doesn't try to go too deep with some of the more obscure facilities. I picked up a tip that I suppose I should have realised but didn't — you shouldn't use SAVE more than once since memory contents can be changed as a result of SAVEing.

The MBasic manual has simply been reset because Adam is obliged to retain the original wording until the end of this year. He'll then look at it and change it where necessary. This manual is not at all bad, though, so it shouldn't be a problem. In general, all the documentation will be brought up to the company's house style before publication.

Incidentally, I should give you the address of Osborne Computers: Osborne Computer Corporation, 26500 Corporate Avenue, Hayward, California 94545, telephone (415) 887 8080.

Users

Who'd use it? My guess is anyone who is taking computing a bit seriously and who either doesn't mind a small screen or who is prepared to forgo a little portability in favour of a separate monitor. The price is good, the facilities offered are more than adequate and, because he's plumped for CP/M, plenty of packages will be quickly available. The sort of dealers that Adam is encouraging are the sort that traditionally sell to the professionals and these are exactly the sort of people that the machine is aimed at. In fact, Adam defines the users as 'professional people using it in the course of their daily work'. It certainly isn't a fun and games machine, although I'm sure that a lot of games will sneak their way onto O-1s. The easiest way for me to describe the market is anyone other than the fun and games, colour and hi-res graphics brigades. I must admit I'm not too sure about number crunching, speed and accuracy either. You'll have to check this out for yourself.

Prices and delivery

The price we have in Australia is $2250 including tax for the Osborne 1 with all its standard software (CP/M, CBasic, MBasic, Wordstar, Mailmerge and Supercalc).

The machine comes with a standard composite video output so that any available monitor can be used. At the moment a 90 day warranty is standard for parts and labour.

Until June 30 only two dealers have been appointed: Computerland and President Office Machines outlets. Next financial year several additional dealers are expected to be appointed and Adam sees the establishment of 'Osborne Australia' sometime in July, presumably to oversee his Australian operations.

Future plans

The machines now being sold here have a new case made of injection-moulded plastic foam in a 'clam shell' arrangement. This means that the inside will be much more accessible for engineers and nosey users. The quaint carrying handle will disappear to be replaced by one moulded into the case. The machine will be lower as a result of having a thinner keyboard unit and it's expected to weigh less. The bezel is expected to be prettier too.

A battery pack is currently under development and the most likely arrangement will be a large flat unit which forms a false bottom to the Osborne 1. Adam expects this to be available by the middle of this year.

Dual-density disk drives should be announced in November or December and communication facilities in six months or so. An 80-column screen with user-defined graphics and a 52-column option is also likely to appear in the near future.

Finally, don t just expect upgrades to be up. Adam is well aware of the potential mass market opportunities for small domestic machines. He hinted at smaller Osbornes as well as bigger ones.

Conclusion

suppose I've said it all in the Users' section. The machine is well made, offers more facilities than any other machine at the price and suffers one enormous drawback: the screen measures just 5in diagonally. This isn't a problem for occasional use — an hour or two even — but I'd hate to use it continuously. To overcome this problem, a 12in monitor is available and I would suggest that you keep this where you'd use the machine most. Making such a sophisticated machine portable was a really neat idea. I think, though, that there will be a lot of wives up and down the country who'll roundly curse Adam Osborne for what he's done.

Getting the thing going is a doddle — easier than filling a kettle and plugging it in. You'll need a printer — most people I know use the Epson MX-80 and it offers excellent value at far less than $1000. Adam Osborne also uses the same printer on his machine, so it would seem ideal. You'll also need disks and stationery to get under way. And then you're in business. I recommend that you consider this machine very seriously among your options.

Benchmark timings

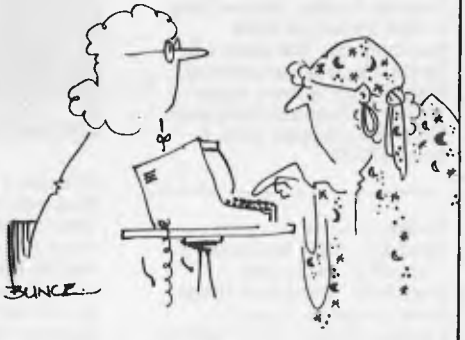
There is nothing wrong with the Osborne's performance on our standard Benchmarks. It came out faster overall than most other machines we've tested. You must remember though that these tests relate mainly to the computer's numerical processing speed and take no account of accuracy, string handling or disk handling. The other thing to bear in mind is that computers spend most of their time waiting for information to be transferred between themselves and their peripheral devices. Timings were made using MBasic. CBasic would have returned still faster times.
All times in seconds.

BM1	1.4
BM2	4.4
BM3	11.7
BM4	11.6
BM5	12.3
BM6	21.9
BM7	34.9
BM8	6.1

Memory map

0000	System read only space; part switches to ROM in shadow mode
4000	Post processing sequence & data buffer RAM
EA00	CBIOS entry points
F000	Memory-mapped video RAM
FFFF	Top of memory

In shadow mode the memory up to 4000H isn't available when CBIOS is operating. To get into and out of shadow memory mode you need to OUT 0 or 1 coupled with a change to location EF08H making that 0 or 1 too. These routines must be above location 4000H.



'You will meet a tall, dark stranger. In all probability within 2.73 days. Apparently 9.2 people out of ten always do.'

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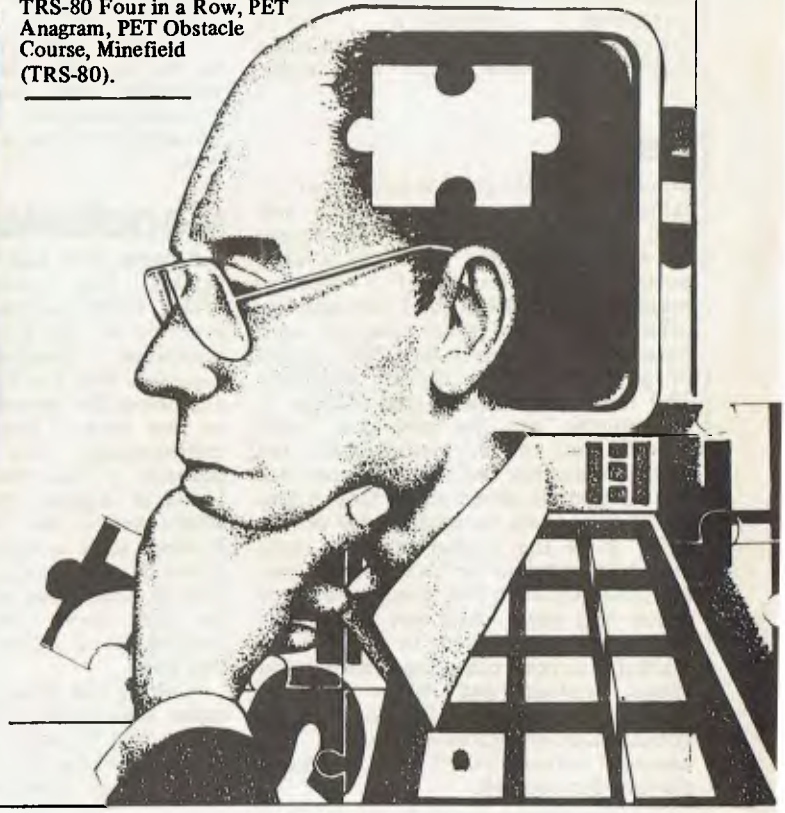

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NEWCOMERS START HERE

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in APC. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, APC will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, **processing** it, storing the results or sending them somewhere else. All this information is called **data** and it comprises numbers, letters and special symbols which can be read by humans. Although the data is accepted and output by the computer in 'human' form, inside it's a different story — it must be held in the form of an electronic code. This code is called **binary** — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or **bits** as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being **ASCII** (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a **byte** and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called **hex**. The hex equivalent of a byte is obtained by giving each half a single character code (0—9, A—F): 0 = 0000, 1 = 0001, 2 = 0010, 3 = 0011, 4 = 0100, 5 = 0101 .... E = 1110 and F = 1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing it with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in **memory** as bytes. The rules are called **programs** and while they can be input in binary or hex (**machine code** programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the **programming language** is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is **Basic**. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To **run** such a program the computer uses an **interpreter** which picks up each English-type **instruction**, translates it into machine code and then feeds it into the **processor** for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are **PEEK** and **POKE**. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to **hardware**, this means the physical components of a computer system as opposed to **software** — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (**CPU**), a single microprocessor chip with supporting devices such as **buffers**, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board (**PCB**) or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a **bus system** is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the **S100**.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, **RAM** (Random Access Memory) and **ROM** (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — **static** and **dynamic**; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called **PROMs** (Programmable ROMs) and **EPROMs** (Eraseable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, **cassettes** and **floppy disks** are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, **floppy disks** are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a **read/write head** across the disk's surface. The disk is divided into concentric rings called **tracks**, each of which is in turn subdivided into **sectors**. Using a program called a **disk operating system**, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: **soft sectoring** where special signals are recorded on the surface and **hard sectoring** where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the **stringy floppy** — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. **Hard disk** systems are also available for micro-computers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit (**VDU**), which looks like a TV screen with a typewriter-style **keyboard**; sometimes these are built into the system, sometimes they're separate. If you want a written record (**hard copy**) of the computer's output, you'll need a **printer**.

The computer can send out and receive information in two forms — **parallel** and **serial**. Parallel input/output (**I/O**) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the **baud rate** and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is **RS232** (or **V24**) while, for parallel interfaces to printers, the **Centronics** standard is popular.

Finally, a **modem** connects a computer, via a serial interface, to the telephone sytem allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need Telecom's permission; instead you could use an **acoustic coupler**, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — Telecom isn't so uppity about the use of these.

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ANS BASIC:

Mike Parr outlines the unexpected features of American National Standard Basic.

Basic is unusual in that, unlike Fortran, Cobol or Pascal, there has been no realistic standard — the nearest we get is the 'de facto' standard of Microsoft, because it is implemented on many micros. A new standard though, will soon make an appearance; American National Standard Basic, which defines a language of greater power than Microsoft (in the following, I'll use ANS, or simply Basic to stand for the new language).

When I first heard of a new standard, I expected some hat-tipping to Microsoft, ie, a tight definition of Microsoft with additional 'structuring' statements, but this is not the case — the ANS designers have gone for a new language that bears little relationship to Microsoft.

This article will examine the new standard, concentrating on new or different features from what we have come to know as Basic. As the standard is some 200 pages long, you'll be pleased to know that many points are omitted but I trust that the main ideas will come across.

Firstly, the standard is written as a set of modules, not all of which need be present in every implementation. You will always have certain 'core' modules, but may not have those dealing with graphics, enhanced file I/O, or real-time. In practice, though it seems likely that any manufacturer wishing to sell an ANS implementation will (at least) need to implement graphics and enhanced file modules.

The language

ANS includes much that can be found in traditional Basic. Perhaps a quick way of describing this is to say that it will accept most Microsoft programs that don't use string variables or multi-statement lines. On top of this, variable names can be up to 31 characters long (all significant). Lower-case characters can be used, and variables can be local to sections of a program. The use of numeric variables is conventional in that they aren't declared and are all floating-point. Lines are numbered and may only contain one statement, though a comment may be added at the end of a statement by prefixing it with an exclamation-mark:

```
30K=K+1 ! INCREMENT COUNTER
```

Control structures

There are two main functions performed by control structures: repetition and selection. For repetition, we have a conventional FOR — NEXT, but also a DO — UNTIL, eg,

```
80 DO UNTIL X>N
90    X=X + 1
100   PRINT X, N
110 LOOP
```

Every structure is delimited by DO and LOOP but we can ring the changes by:

a) using WHILE instead of UNTIL
b) placing the terminating condition after LOOP
c) breaking out of the loop by an EXIT IF statement.

Here's a couple of examples:

```
120 DO
130   X=X + 1
140 LOOP WHILE X<N

150 DO UNTIL K>10
160   EXIT IF A(K)=0
170   K=K + 1
180 LOOP
```

For selection, we have traditional single-line IF statements, but also multi-line IF. . .END IF and SELECT (case) statements, eg,

```
190 IF X>=0 THEN
200   Y=SQR(X)
210   PRINT Y
220 ELSE
230   PRINT "NO SQUARE ROOT"
240 END IF
250 SELECT AGE
260   CASE<16
270     PRINT "NOT WORKING"
280   CASE 16TO 65
290   PRINT "WORKING"
300    CASE ELSE
310   PRINT "RETIRED"
320 END CASE
```

If you like to design programs with a pseudo-code approach, these control structures should fit the bill.

Strings

The implementation of strings is radically different from that in Microsoft. Firstly, the maximum string length is implementation-dependent, but must be a minimum of 72. Secondly, the familiar LEFT$ and RIGHT$ are replaced by a 'substring qualifier', as in:

```
10 A$="ABCDEFG"
20 B$=A$(2:5)
```

Here, the bracketed qualifier specifies characters 2 through 5; thus B$ becomes 'BCDE'. Qualifiers may also appear to the left of an assignment, eg,

```
30 A$(2:3)=A$(4:6)
```

would set positions 2 and 3 of A$ to 'DEF', resulting in the value 'ADEFDEFG'. To save you the trouble of writing the Microsoft equivalent, it is:

```
30 A$=LEFT$(AS,1) + (MID$(AS,4,3) + RIGHT$(AS,4)
```

ANS also has a concatenation operation '&', together with string functions, the main ones being:

CHR$(N)	] character/internal code conversion
ORD$(X$)	
LWRC$(X$)	] lower/upper case conversion
UPRC$(X$)	
STR$(N)	] character/number conversion
VAL(X$)	
LEN(X$)	length of a string
POS(X$, Y$)	substring search (the Microsoft INSTR)

Arrays

Surprisingly, only a maximum of two subscripts are allowed, but a number of very useful features exist:

a) several matrix functions, eg,

```
40 MAT A=INV(B)
```

b) the ability to pass an array of any size to a function, eg,

```
50 X=FINDMAX(A())
```

c) a SIZE function to find the maximum allowed subscript, eg,

```
60 N=SIZE (A,2)
```

sets N to the largest possible value for the second subscript of array A.

d) character string arrays exist as in Microsoft, but ANS allows their use in MAT statements, eg,

```
70 MAT A$=A$ & "."
```

would put '.' at the end of every string element of array A$.

IS IT THE ANSWER?

ANS BASIC

Segmentation

Together with GOSUB/RETURN, ANS provides three other methods of splitting programs into modules. Firstly, there's a CHAIN statement, which can load and run complete programs — many existing Basic systems have this facility. Secondly, as well as the familiar single-line function definition, we have a multi-line version, as illustrated by:

```
350 DEF BIGGEST (A, B)
360   IF A>=B
370    THEN DEFEXIT BIGGEST=A
380    ELSE DEFEXIT BIGGEST=B
390   END IF
400 END DEF
```

Note DEFEXIT, which returns control to the calling program, with a result assigned to the function name.

We could use such a function by:

```
35 X=BIGGEST (G, SIN(Y))
45 PRINT BIGGEST (K+3, T)
```

Thirdly we have a subprogram, similar in concept to a Pascal procedure, eg,

```
410 DEF SWAP (A, B)
420   TEMP=A
430   A=B
440   B=TEMP
450 END SUB
```

and we could make use of this (to interchange the values of two variables) by:

```
55 CALL SWAP (G, N)
```

Functions and subprograms have facilities for string and array parameters, together with the allocation of local variables each time a module is entered. Among other things, this simplifies the business of writing recursive routines.

At first sight, it may seem that functions and subprograms are very similar, but the crucial difference is in the way parameters are passed: in a function, a copy of the value of a parameter is made available, but in a subprogram a reference (similar to an address) is provided. What this means in practical terms is that given only the copy of a value, a function can't change the original value. However, if a subprogram has a reference to an item (be it an array or simple variable), then its value can be altered.

Input-output

'Core' ANS Basic has sequential files only, but an interesting feature is the ASK statement, by which a program can make enquiries about a file, eg,

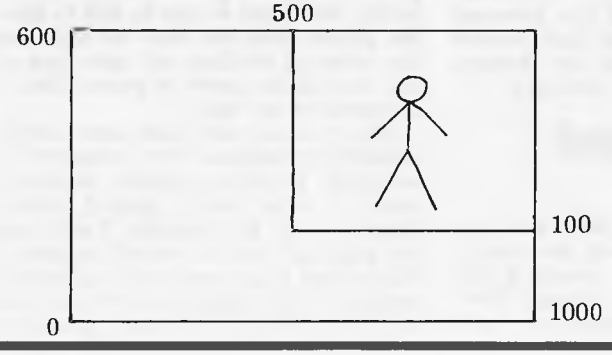
```
500 ASK#3: ACCESS A$
```

This set A$ to either 'INPUT' or 'OUTPUT', depending on how the file was opened. If you are lucky enough to have Basic with 'enhanced' file facilities, you also get random and indexed-sequential files.

Graphics

Most languages don't have built-in graphics, hence the incomprehensible use of PEEK/POKE on many Microsoft systems. Let's examine some features of the ANS graphics module.

Assume that we want to plot in a square at the top right of the screen:



In other words, the physical screen ranges from 0 to 600 vertically, and 0 to 1000 horizontally, and we need to select a certain area. In Basic, we do this by —

```
600 SET VIEWPORT 500, 1000, 100, 600
```

in which the order of the values is: left, right, lower, upper. Unfortunately, the coordinates of our square are likely to be unsuitable for our problem so Basic allows us to define a mapping, eg,

```
610 SET WINDOW -100, 100, -100, 100
```

which gives us an origin at the centre, and 100 units in each direction. Once the plotting area is set up, we can use the PLOT statement, eg,

```
620 PLOT X,Y
```

Here, the beam is moved to the position specified by the values of X and Y, and then switched off. To leave the beam on, a semicolon is used, eg,

```
630 PLOT A,B;
```

In one PLOT, we may use several points, so to draw a square:

```
640 PLOT 0,0; 0,1; 1,1; 1,0; 0,0
```

Progressing to more advanced features, we can define routines which draw objects (called pictures) and transform them with rotation, scaling and positioning:

```
700 PICTURE SQUARE
710 PLOT 0,0; 0,1; 1,1; 1,0; 0,0
720 END PICTURE
```

So, to plot the square we can use:

```
65 PLOT SQUARE
```

and to plot it half-scale and rotated by 45 degrees:

```
75 PLOT SQUARE WITH SCALE(0.5) * ROTATE(45)
```

Finally, in a similar manner to file enquiries, we may ask about facilities:

```
730 ASK VIEWPORT A,B,C, D
```

Real time

In a real-time system (eg, control of a chemical plant) the computer may have to perform tasks such as:

- examine a thermocouple every second;
- ring a bell every eight hours;
- detect when an alarm button is pressed;
- write some information to disk.

But, at any instant, several such activities may be partially completed: they proceed in parallel and such activities may be defined:

```
800 PARACT WORKSHIFT
810  WAIT DELAY 8*60*60 ! 8 HOURS
820  PRINT "SHIFT COMPLETED"
830 PAREND
```

This activity may be initiated by:

```
85 START WORKSHIFT
```

The result of this WAIT is that execution may proceed to other parts of the program, control only returning to line 820 after the specified delay.

However, there's more to real-time systems than this and Basic also provides for the suspension of activities until events occur, and for passing messages between parallel activities.

The future

After this quick look at the language, would you want to use it? More precisely, how does it compare with (say) Pascal, Comal, and other Basics?

ANS Basic has very good control structures — better than Pascal — but is weak in the data-structuring area, eg, no records or user-defined types. Also it's insecure compared to Pascal; mis-spelled identifiers may not be detected.

The graphics and real-time modules are attractive and relatively easy to use but ANS will have to stand against competition from existing languages supplemented by systems software (eg, graphics packages, real-time operating systems), or in the future, competition from Ada.

Perhaps it is doomed to be treated as just another Basic dialect, and users will stick to the devil they know — if manufacturers take this attitude, will it ever be implemented?

GRAPHICS

Alan Sutcliffe reveals a little known solution to the 'hidden surfaces' problem in graphics.

Representing reality—by which is meant the appearance of things—presents many problems that do not arise in making two-dimensional non-representational patterns. One such problem—or rather a whole group of problems—is to do with the removal of hidden lines and surfaces in showing a three-dimensional scene. What bits of the picture lie behind which other bits and so should not be drawn, or should be drawn and then overwritten by what lies in front of them?

How the problem presents itself and how it can be solved depends a lot on the type of output display used and the way objects are shown. When I did a short animated sequence of an imaginary landscape for the film 'Alien' a few years ago I was able to use a simple approach —there was no time for anything else. A vector graphics device was used, so the scene was made up of a set of straight lines. I chose to show the form of the land by having a series of more or less horizontal lines going across the screen, those further up representing points further away from the viewpoint. Any bump in a line appears as a hill, and any dip as a hollow. Figure 1 shows the method. Each line can only obscure those above (behind) it, and be obscured by those below (in front of) it. Each line represents a horizon up to that level.

The rules for drawing the lines should now be clear, given a set of three-dimensional coordinates for the terrain at a number of grid points, and the position of the viewpoint:

* Calculate the first, bottom line, and draw it. Nothing is in front of this so it is all visible. It establishes a horizon.
* Calculate the next line, and determine which parts of it, if any, fall below the horizon: ignore any that do and draw the rest. This establishes a new horizon. Repeat this last step until all the lines are drawn and the scene is complete.

There is an article in the June 1981 issue of *Creative Computing*, reprinted in *Video* in September 1981, that describes the method and the program in detail. The basis is obviously nearest first.

Hidden surfaces

In a picture composed of areas rather than lines, a similar approach can be used. This is the form most suitable for most micro-systems. Plotting areas rather than lines has one big advantage: it is not necessary to compute just which parts of an area are hidden. If the areas are drawn in the order from furthest first to nearest last the plotting process takes care of this by overwriting any areas that are hidden.

This approach of drawing surfaces in the order of their distance from the point of view is often given as the best, or even the only, way of solving the hidden surface problem. It is certainly not the only method, and it may not be the best. It has two possible disadvantages.

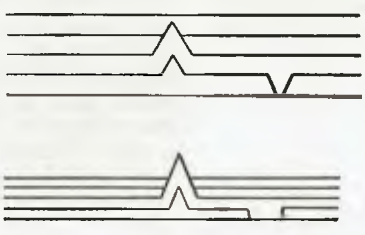


Fig 1 Simple hidden line: 2 views of the same data.

1. The order in which surfaces are to be plotted depends on the distance from the point of view, and so must be computed afresh for each new viewpoint.
2. The notion of which of two surfaces is nearer to a given point in three dimensions can be ambiguous: a long strip of surface may extend both nearer and further from the viewpoint than a small patch. It is then necessary to go into just which little bit of the long strip is in line with the small patch in the direct line of sight, and then which of these is nearer. That is complicated and time-consuming, and can entail drawing rays out from the viewpoint in all directions to see in which order they skewer the surfaces.

The rest of this article describes a way of dealing with hidden surfaces in which much or even all of the computation about the order of plotting the surfaces is independent of the viewpoint and can be carried out once and for all at the beginning of the program for each fixed scene—say the model of a city—rather than for each different viewpoint in an animated sequence.

This may seem contrary to your intuition—it certainly did to mine when I first found this method—and that may be one reason it does not seem to be much discussed. It is also what makes it particularly interesting. Even in the excellent 'Horizon' programme on American computer graphics shown on TV at Christmas, one of the foremost experts in California said that hidden surface removal depends on distance from the point of view. It does not.

Assumptions and definitions

This part of the article deals with the background to the method, the theory, while next month I will present a program to implement it on a micro. First there are some assumptions and definitions to give.

* Each surface of the scene is flat, and lies entirely in one plane.
* Each surface may have any shape of outline, and may even have holes in it, like windows in a wall.
* Each surface is one-sided, that is it has a front and a back and can only be seen from the front.
* If a surface is wanted that can be seen from both sides, like the inside and outside of a wall, then these sides must appear separately in the catalogue of surfaces: they will differ only in sign, + or -. Often it is enough to keep only the outside surfaces, as in the model of a city where the buildings do not have windows through which the insides can be seen (quite normal in architectural models), and where the city is only to be seen from outside the buildings—the view from inside a windowless block is pretty dull, anyway.
* The sign of a surface may be thought of as indicating whether it faces towards or away from the origin of the co-ordinate system in which the model is stored. More of that when we come to details of the program.

I must also say a few words about what is *not* being dealt with in this article. Two important aspects are assumed to be dealt with by the program without giving details. They are perspective and 'clipping'—that is, what part of the scene visible from the viewpoint actually falls within the viewing window, assuming that a total 360° panorama is not being presented. These are both matters that depend on the point of view, and I am concerned with what can be sorted out before that is decided.

A simple example

Here then, is the basis of the method: imagine two surfaces, a patch of ground and a wall nearby but not on the patch. Remember that both surfaces are one-sided and invisible from the back. The underside of the ground can be ignored because we are not going to look at the scene from below ground. So the patch of ground can never obscure any part of the wall. The wall may or may not obscure some part of the patch of ground, depending on which way it is facing. But it will always be safe to draw the ground first and then the wall, and the order of plotting will take care of any part of the patch of ground that is obscured by the wall.

But, you may say, these aren't all the possibilities—because the viewpoint is restricted to above ground. Assume a point of view below ground, then—down a well, for example. From here the patch of ground cannot be seen at all, so there is no question of it obscuring anything. What might obscure the wall is the underside of the ground—a

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different surface—or more likely the sides of the well. Thus, returning to the wall and patch of ground, the order of plotting them is determined once and for all, for any viewpoint. The steps needed for this simple case are as follows. Make the fixed list Ground, Wall, for all points of view.

As the scene is to be plotted, for each surface in turn and for each point of view, determine if the point of view is in front of the surface, if so draw it, otherwise ignore it.

The distance of the point of view from the wall and ground are not computed or considered at all. The determination of which side of a surface a point is on is simple: put the coordinates of the point in the equation of the surface, and test the sign of the result. For a one-sided surface this must then be multiplied by the sign of the surface, but if the equation is stored in the right form this will all be part of the same step. If the equation of a surface is $x + 2y + 3z + 4 = 0$, this can be taken as the equation of the upper surface; while that for the lower surface is simply $- x - 2y - 3z - 4 = 0$. The point (1,1,1) for example gives $1+2+3+4 = 10$, which is positive when substituted in the first surface, so it is in front of this. In the second equation it gives -10, and so is behind it.

A zero value would indicate that the point of view was in the same plane as the surface in question, and the convention is that the surface is then invisible, having no thickness. Zero is lumped with negative: in the plane but behind it. But this is taking us too far into the detail of implementing the method before its validity has been established.

Analysis of cases

In many cases the order in which the surfaces are plotted does not matter at all. Consider a cube which is seen from the outside only. It has 6 one-sided surfaces. There is no point of view from which any of them obscures any other. All they can do is get in front of the backs of some of the other surfaces, but these are invisible anyway. So in a scene consisting of only a single cube the list of surfaces can be in any order. The same is true of any convex object, such as a near-sphere composed of hundreds of small facets each too small to see. Every outside surface is back-to-back with every other outside surface.

If the cube had windows and inside walls, and could be viewed from both inside and outside, the situation is not much more complicated. No inside surface can get in front of an outside one, or in front of another inside surface. Each outside surface can obscure some inside surfaces but no outside ones, as noted above. The order of plotting is therefore all (visible) inside surfaces in any order, then all (visible) outside surfaces in any order. Again this applies to any convex body.

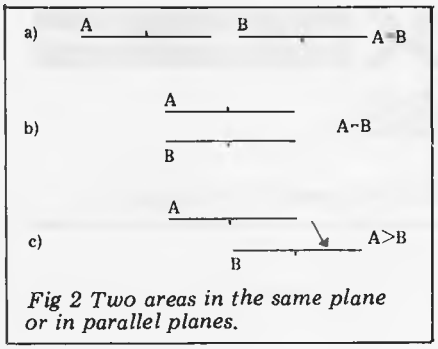


Fig 2 Two areas in the same plane or in parallel planes.

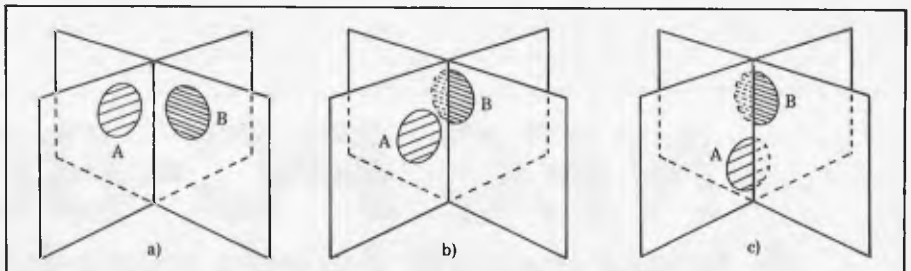


Fig 3 Three cases of areas on intersecting planes.

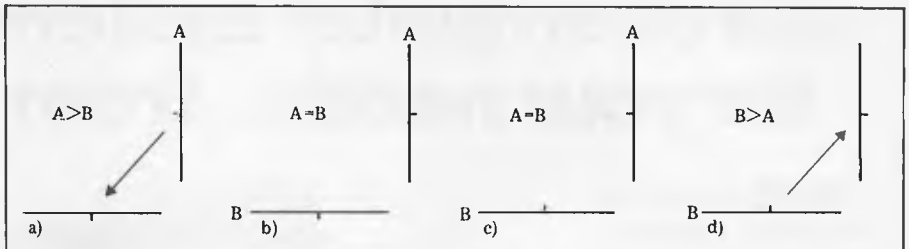


Fig 4 Four sub cases corresponding to 3 a). Arrow indicates line of sight

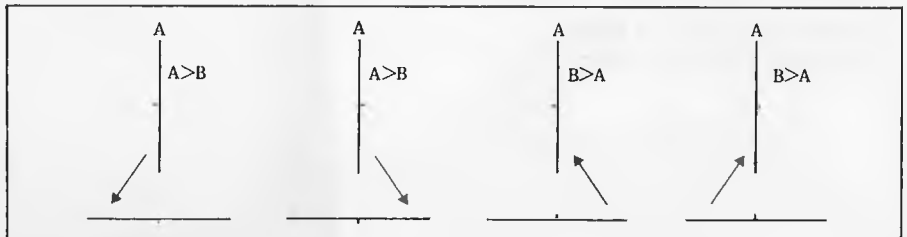


Fig 5 Four sub cases corresponding to 3 b).

For concave bodies and for more complex scenes the situation is more complicated, but in many cases the order of plotting can be decided for all viewpoints. To show this we must abandon this study of particular cases and launch into more basic analysis. This consists of considering in turn all possible relationships between a pair of surfaces. Most of these are straightforward, but there is one set of awkward cases at the end. This is best explained with a set of diagrams in which each of the 2 surfaces is seen end on and so just appears as a line.

A little bit of notation. The two surfaces are A and B.

A ⟩ B means that A can obscure B

A ⟨ B means that B can obscure A

A = B means that neither can obscure the other.

Now refer to the diagrams in turn.

2a) A and B are in the same plane, so neither can obscure the other: A = B.

2b) A and B are in parallel planes and face in opposite directions, either both inward or both outwards. A = B.

2c) A and B are in parallel planes and both face the same way. A ⟩ B.

In the diagrams the convention is that the plain side of the line is the front, visible side of the surface, and the one with the small mark is the back, invisible side.

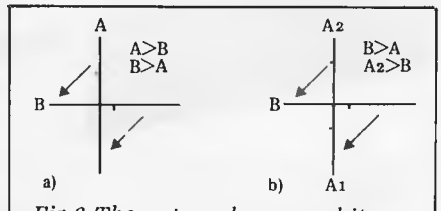


Fig 6 The awkward case and its resolution

If the surfaces are in skew planes—that is planes that intersect—they do so along a line. There are 3 possible arrangements to consider, shown in Figure 3.

3a) The line of intersection passes through neither surface.

3b) The line of intersection passes through one surface, say B, but not the other.

3c) The line of intersection passes through both A and B. This is the awkward case.

Now we must look at each of these cases in more detail, returning to the edge-on view, looking down the line of intersection of the planes. Figure 4 shows the four sub-cases from 3a and the resulting visibility relation in each cases. There is no other way in which two such surfaces can be arranged. Figure 5 shows the detail for 3b, and is again complete. Figure 6 shows the awkward case, and the reason for it is that part of A can obscure B, and part of B can obscure A. Our system breaks down because there is not a single fixed relation between A and B. In fact, this case is a problem for any method, because both relations can hold even from a single viewpoint; plotting A then B may fail, and plotting B then A may fail. The solution, in any method, is to split one of the surfaces into two parts along the line of intersection. This decomposes the case into three surfaces which can be taken in pairs. A_1 and A_2

are case 2a and so $A_1 = A_2$. A_1 and B is case 5d) and so $B \rangle A_1$. A_2 and B is case 5a) and so $A_2 \rangle B$ (see Figures).

Given this decomposition, we have derived for every pair of surfaces in a scene a single fixed visibility relation which holds for all points of view.

Graphs and cycles

This is good, but not all we wanted. It is still possible that there are cyclic loops among these relations of the kind A ⟩ B, B ⟩ C and C ⟩ A, as shown in Figure 7. If there are such loops, then the relation to be used to determine the order of plotting can only be settled when the viewpoint is known. If there are no such loops, then it is possible to draw up a fixed list of plotting order for all viewpoints. In any case it will be possible to draw up a partial list, leaving as little as possible to be decided for each viewpoint.

Thus the next main steps in the process are to convert the data on relations between pairs of surfaces as far as possible into a list of plotting order, that is, until some loop is encountered that cannot be resolved. The way to start this list is to look for two kinds of surface: those that obscure no other surface, and those that are obscured by no other surface. Those of the first kind can be put at the head of the list of plotting order, to be plotted first, while those of the second kind can be put at the bottom of the list. This process can then be repeated and the list built up, from the top down and from the bottom up.

A simple example should make this clear. Consider two vertical square blocks arranged as in the plan view of Figure 8. Forget the tops and bases of these blocks and look only at the sides. Clearly A, B, G and H each have nothing obscuring them, so they may be put at the bottom of the list and plotted last, in any order. Equally C and E obscure nothing and so may be put at the top of the list of plotting order. These surfaces can now be removed from the diagram, leaving only D and F. Neither of these now obscure anything and so they may be put in the middle of the list which is complete:

C, E
D, F
A, B, G, H

If the columns are the same height, the tops and bases can be added to the list with no trouble: they are all in the category of being obscured by nothing and so go on the last line with A, B, G and H. The order of plotting within a line does not matter.

How are these relationships stored and manipulated inside the program? There is a two-dimensional array with an element for each ordered pair of surfaces, where their row and column intersect. Suppose the relations are A ⟩ B, A ⟩ C, A ⟩ D, A ⟩ E, B ⟩ D, B ⟩ E and C ⟩ E. The array for this data would look like:

From \ To	A	B	C	D	E
A		1	1	1	1
B				1	1
C					1
D					
E					

A helpful way of thinking about this data is as a directed graph. Each surface is represented by a point, and the relation A ⟩ B is represented by a line from A to B with an arrow indicating its direction. The same data is shown in this form in Figure 9. Here are the rules for converting this data on relations into a list of plotting order, expressed in terms of the directed graph.

1. A point which has only lines leading to it can be placed at the head of the list —but below any already put at the head —and erased from the graph.
2. A point which only has lines leading from it can similarly be placed at the bottom of the list, but above any already put at the bottom.
3. A point with no lines leading to or from it can be dealt with either as for 1 or for 2 above.

In every case, the point and all the lines connected to it can be removed from the graph when the point is put on the list. This may well bring other points into one of the categories 1, 2 or 3 which can be dealt with even though until this stage they were in the fourth category of having lines leading both to and from them, and so not capable of being transferred to the list under the rules above.

It is this process of peeling off successive layers from the top and bottom that makes it difficult, looking at the data for all but the simplest graphs, to tell whether it is going to be possible to complete the plotting list or whether some loops will turn up to frustrate the process.

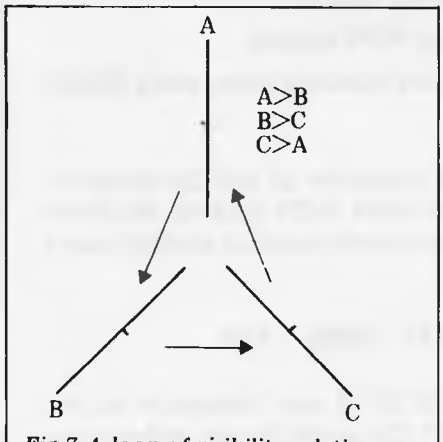


Fig 7 A loop of visibility relations.

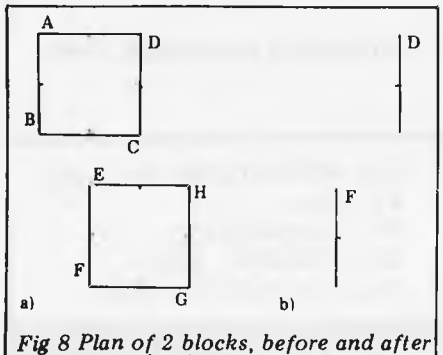


Fig 8 Plan of 2 blocks, before and after transfer of the first set of surfaces.

Processing an array

The rules above can be reformulated in terms of the data in an array. Compare

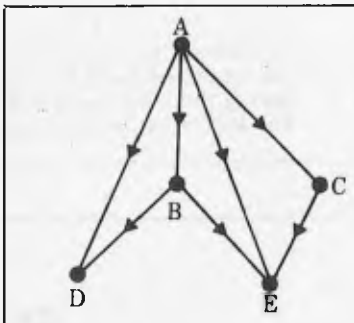


Fig 9 Directed graph representing data in the array.

the array above and figure 9.

1. A point that only has lines leading to it (a surface that obscures no other) has its row blank in the array. D and E in the example.
2. A point that only has lines leading from it (a surface that is obscured by no other) has its column blank in the array. A in the example.

Removing D, E and A from the array leaves only B and C with no line connecting them.

From \ To	B	C
B		
C		

These can be added to the middle of the list completing it:

D, E
B, C
A

The rules can therefore be restated in the following terms.

Rule 1: Remove from the array any surface with a blank row and put it at the top (inner) of the list.

Rule 2: Remove from the array any surface that has a blank column and put it at the bottom (inner) of the list.

Any isolated surface with both blank row and column will get dealt with by one of these rules and a third rule for them is not needed.

Continue applying these rules in turn until either all the surfaces have been transferred to the list and none is left in the array, or until all that can be have been transferred and further progress is frustrated by a loop of relations in the array. To recap, the stages in the whole procedure are as follows:

1. Take each pair of surfaces in turn:

a) If the plane of each surface cuts the other surface (the awkward case), divide one of the surfaces along the line of intersection.

b) When all such divisions have been carried out, for each pair of surfaces determine the visibility relation and record it in the array.

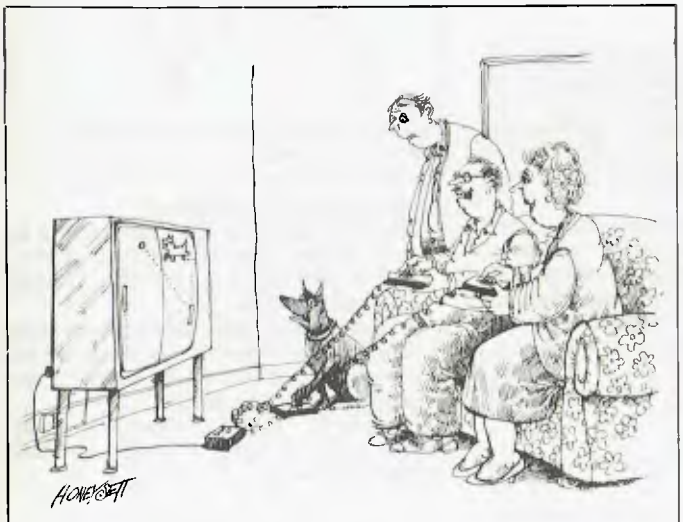
2. Transform the array as far as possible into a list of plotting order. This is a fairly heavy load of computing, but the savings can be considerable over computing the relations and distances for

PATTERNS

each viewpoint. Even if the list can only partially be set up there should be some saving in reducing the work needed for each view. The following further stages are needed for each viewpoint.

3. Remove any surfaces from the list not visible from this viewpoint.
4. a) If there are points still left in the array, remove any not visible from this point of view.
   b) For those remaining, transform them using the same rules as before into further items in the list.
5. With the list complete, draw the surfaces in the order of the list. This order of plotting will take care of what obscures what. That which should be hidden will be hidden and that which should show will show.

Next month I will present the code that implements some of these stages, particularly the part dealing with the conversion of the array into the list, and give an example of its application to a particular set of data representing a small model. END



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FRAMES OF REFERENCE

A DP MANAGER'S GUIDE TO MICROS

By Alan Wood

All but the smallest companies with no computers are constrained by the systems they have already implemented. A medium-sized organisation with a turnover of $100 million will have a mainframe for its accounting system, and, perhaps, a mini for order processing and stock control. Large organisations will have a mish-mash of mainframes, minis, data entry systems and, nowadays, some dedicated word processing systems. Both medium and large companies are subscribing to one or more timesharing services. Much of what has taken several years to implement on mainframes may only now be showing a return. The minis in place, typically for interactive order processing, should have provided a quicker payback.

Computer systems in situ and paying for themselves are best left well alone. The better areas for microcomputers are: completely new systems in the office; applications around the inaccessible fringe of big data processing systems; and timesharing replacement tasks. Tackling these areas will be a prelude to more complete distribution of computers to desktops as powerful micros take hold and link into communication networks and big file systems. When planning future strategy for these systems, it is essential to review the current computing constraints and resources of the company. In particular: mainframe computing; minicomputing; timesharing; word and other processing; communications networks; existing computing expertise; and DP policy and company systems.

Mainframe computing

The introduction of microcomputers into a large company with its own main frame computer will accelerate some of the trends established when minicomputers were introduced.

Some of the current mainframe tasks can be replaced by microcomputer systems. More frequently, however, the tasks performed on micros will be those that never got high enough on the priority list or simply were not economically justified on mainframes. Consequently, it is expected that microcomputing will result in a better understanding and enthusiasm for computing

PART 3 MICROS IN MAINFRAME COMPANY

in general, resulting in a growth in demand for all types of computing. Further dispersal of applications on micros can also free mainframes clogged with smaller tasks allowing them to respond better to major company systems.

Mainframe computing will, however, change. Users with limited processing power and storage capacities locally will be seeking to access large central databases. The choice of microcomputer is not significantly affected by the current mainframe, but the choice of mainframe applications will be affected by the increasing capability of microcomputers. The strategy established for mainframe computing should be reviewed so that a general computing strategy to meet future company needs reflects the capabilities and costs of micro technology.

Gradually the incumbent mainframe manufacturers are being forced to come up with their answer to the ubiquitous microcomputer. Of the mainframe suppliers, IBM and ICL have already produced some reply and Univac, Honeywell and the others cannot be too far away — unless they are totally deaf to the strident calls of the new technology. So far, IBM's Personal Computer offers nothing new except the IBM label on an Intel chip and industry standard software, the acknowledgement of which is the most significant feature of IBM's micro. IBM has clearly understood the trends and requirements and, given this reading and the IBM name, it is bound to sell in volume. But IBM has not provided an easy answer for computing management. It has only produced a personal computer, the lowest animal in the micro world, and there is no sign yet of a powerful multi-user micro and no local area network. It seems unlikely that either of these products will be seen for some time, if they ever appear at all. Powerful micro systems would seriously undermine IBM's existing product line and it has not tooled up to provide early and much cheaper replacement products.

Minicomputing

Much of the comment on mainframe computing applies also to minicomputing. Smaller minis will be replaced with large micros, much as large 'minis' have come to replace older mainframes. Micros are rapidly becoming more powerful, and the overlap with small minis is already significant. Expertise gained in minicomputing is directly applicable to large microcomputers. The term 'micro' and 'mini' will become less significant. Intel has already introduced the term 'mainframemicro' with the launch of its 32-bit, 3-chip processor. The 16-bit 'minimicros' will be soon as

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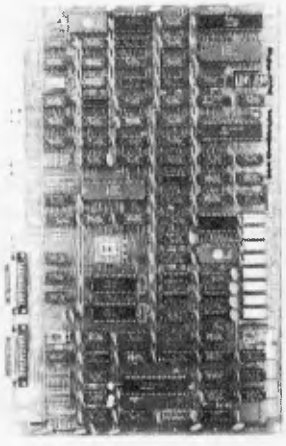

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FRAMES OF REFERENCE

commonplace as PETs and Apples — indeed those machines are soon to have 16-bit processors of their own.

The mini manufacturers, already showing a reduction in growth compared to the breakneck pace of the '70s, are beginning to respond with their micro offerings. Some have read the market well, while others have made the mistakes evident in some mainframe suppliers. DEC has had a micro, the LSI 11, for as long as anyone. The range based on this chip has been very successful, right up to the PDP 11/23 multi-user sytem. Data General also had the MicroNova for some while. Both the DEC and Data General micros are old 16-bit technology — not as compact, as cheap or nearly as powerful as the new 16-bit chips which are now displacing them.

Data General will shortly be moving into the Desktop micro market with a relaunch of the MicroNova in new packaging, the Enterprise. It has laboured for over two years to bring the machine to market with its own software, while the market has been rapidly moving away from it to industry standard software. DG seems to have misread microcomputing as badly as it completely missed the word processing and office automation market into which Wang rocketed. Hewlett-Packard, on the other hand, seems all set to provide a full line from the personal computer with industry standard software, the HP125, right up to its big mainframe replacement machines. The HP125 provides the very successful industry standard operating system, CP/M, over 100 CP/M packages and Visicalc. Endorsement by HP and IBMs of the independent software producers is the equivalent of hi-fi manufacturers making sure pop records can be played on their machines.

Timesharing

The displacement of timesharing services is one of the most rewarding applications for microcomputers. As more packages become available on more powerful micros, this trend will accelerate. Financial modelling, linear programming and PERT are three common applications for today's micros.

Many timesharing systems are personal systems, involving a large amount of interaction with the user. Such applications are ideally suited to a microcomputer. Microcomputer solutions will usually be cheaper, will give a faster, less frustrating response and will allow the user total control over his system. A local microcomputer can also be used to access the wealth of programs and databases on timesharing machines, thus extending the use of the facility. The programming skills required to develop microcomputer systems are similar to those for timesharing systems, ie, programming in Basic, APL and Fortran.

A number of timesharing companies have already started to offer micro front ends to their services. They are recognising the inevitable — if you can't beat them you'd best join them. The microcomputer can cut down the cost of data entry on timesharing services, as well as providing local computing capability off-line for word and numeric processing. The 16-bit micros are complete replacement machines for all but the highly specialised number crunching and big database timesharing services. With one megabyte of 16-bit RAM and a 10 MHz processor, you can perform some vast calculations and, since it will not cost you in connect or CPU time, you can always leave your desktop minimicro on all night to perform heavyweight jobs.

Word and other processing

Many people are using micros as word processing machines. Others purchase dedicated, purpose-built word processors, which in any case are based on micro chips. In the near future they will require both types of machine to communicate with each other as part of an electronic mail system. Viewdata services are gradually gaining ground as information providers to the larger company. Yet again, the ubiquitous microcomputer can be used as a viewdata terminal by plugging in the appropriate software and hardware. Word processing on microcomputers is not as simple or as sophisticated as on dedicated word processors. Sophistication is not so important since, as on fancy calculators, the clever features that sell the machine are seldom used. The simplicity factor is important, especially if you are dealing with typing pool word processing. WordStar, the most popular word-processor on CP/M micros, is not 'user friendly' compared to the dedicated word processor. WordStar will work on a standard VDU and can be configured to run on all the popular makes of VDU. This means that the same VDU can be used for standard data processing and the normal cursor control features are available to the programmer. But it also means that the commands appear on the screen and there are no one-step function keys as with the dedicated word processor. Because of the popularity of the WordStar, VDU suppliers are now producing WordStar options on their keyboards to make the package simpler and quicker to use.

There is no simple rule-of-thumb for choosing between a dedicated and a microcomputer word processor. If the application is 75 per cent word processing, you will be better off with a dedicated machine. If the application is part data processing and part word processing, a microcomputer is the solution. However, if you look at the office of tomorrow linked into computing and communications, general purpose microcomputers are likely to provide more flexibility. For example, a two-station microcomputer could service an executive and secretary, where the one is performing financial planning, the other word processing and both are sharing an electronic filing cabinet. The combination of information management with numeric word processing is becoming increasingly common. On the same station, the office team could also link into private viewdata and have a mainframe connection. Recognising these trends, Wang has recently put the CP/M operating system on the Wangwriter to provide access to the CP/M software bank. Digital Research has also implemented CP/M on the IBM Displaywriter (available only in the US and Canada at the moment).

Communications network

The demands of all the new computing are going to overburden existing communication networks. The requirements for voice, fax, video and data transmission both within buildings and to and from remote locations are creating demands for much more sophisticated and much faster communications channels. Micros are just adding to the load and bringing the demands forward by placing computers in the hands of more and more users who want to communicate with one another. A variety of architectures is being developed to meet these demands, one of the most significant in microcomputing being local area networks.

Like microcomputers themselves, local networks vary enormously in sophistication. The simplest provide a means of slaving a number of micros off a master machine and sharing data storage. A second level provides fast site communications and the capability to string hundreds of devices around a building, effectively replacing the multi-user minicomputer. At a higher level still come those universal networking and data management systems which provide for the intermixing and interchange of data between otherwise incompatible mainframes, minis, word-processors, micros and other digital devices.

Existing computing expertise

This is the most important current resource to consider. Computer departments have established a wealth of expertise over the years and it is a considerable company asset. Much of what has been learnt in mainframe and minicomputing is valid for microcomputing, although the better computer departments question the relevance of this experience to the latest technology. Skills must be updated on micros, and additional expertise in hardware engineering should be added. But computer departments can become better equipped to support microcomputing than any other department. In establishing a rationale for microcomputing, it will be especially important to consider existing software skills and programming languages.

New computing is changing the role of management service and computer managers. More and more they have to function as consultants and contract negotiators, steering the organisation through the maze of technology and buying in most of the software and complete systems needed to satisfy their requirements. The job is becoming less a line management, recruitment and staff motivation function and more a super-

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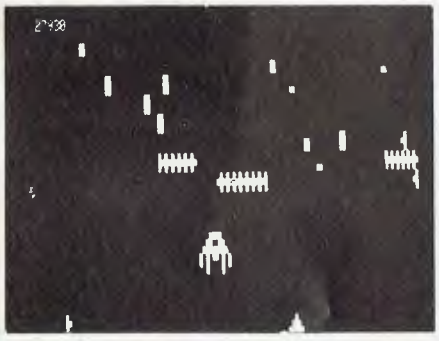

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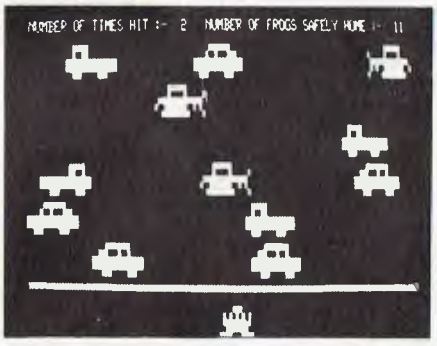

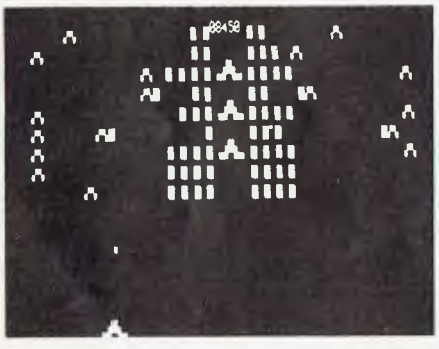

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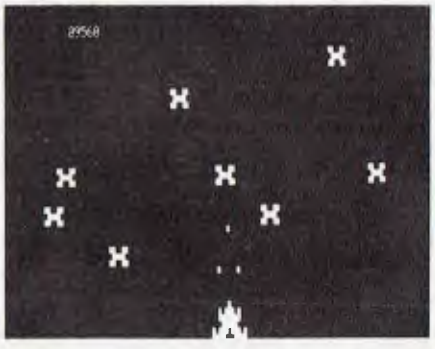

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consultant and purchasing management position. The trend began with minicomputers and is accelerated by micro technology. Some of the actions which flow from the changes are to: ensure you have a consulting function available to your department; design a software strategy that takes advantage of packages from software manufacturers on mainframes, minis and micros; develop and disperse in the direction of software availability and suitability; buy in turnkey systems rather than build new technology teams; and pursue self-education with a technology update and training in purchasing as a minimum.

DP policy

The introduction and application of microcomputers should fit within a revised DP policy which relates current and future technology to the present and future needs of the organisation.

It is important to draw a clear distinction between company systems — those that are integral to the company's business — and personal systems — those that are peculiar to one or more indiduals. For example, micros have been very successfully deployed for goods receiving, warehouse stock location local stock control, and branch information processing. These are all company systems, frequently with multiple sites. They must be controlled from a central point. Time-sharing replacement systems — modelling, for example — are often personal systems, an extension to an individual's skill. If the individual leaves the company, his successor may employ different techniques to achieve the same results. Personal systems should be approached with the same passion for central control associated with company systems. A very fruitful route for future planning is the development of company packages on micros that can be used on many sites. Company packages can greatly increase efficiency, keep development costs down and avoid re-invention of solutions to the same problems. Provided as turnkey sytems to users, they are one pointer to the future role of data processing departments.

Other factors

When developing a strategy for microcomputing, each organisation should establish a list of significant factors affecting such a policy.

1. Company environment: As well as computing resources and constraints, there are company constraints; the implementation of microcomputing has to take into account the company environment. The nature of the business is clearly important; for example, a manufacturing business has different microcomputing requirements from those of a service industry. The company structure has a strong influence on the manner in which microcomputers are introduced and should be carefully considered. It is vital that control of microcomputing be situated at the right place in the company structure. The new technology will have a profound effect on the company as a whole and the computer department in particular. Important changes of this nature invariably lead to problems of internal politics with different departments seeking control. Microcomputing will have a strong influence on future company policies for several aspects of the company's business. For example, it is likely that turnkey micro systems will lead to staff retraining and redeployment. The planning of future staffing must be integral to the introduction of new technology. Like other computer systems before them, micros are at their best and are most frequently used in areas where business is expanding. Put in the hands of interested users, the new technology will create a base of new products and services as well as improve productivity.

2. Users' attitude towards DP: It would be unrealistic to assume that all users are favourably disposed towards DP departments. Disappointments with previous computing, frustrations over delays and costs, and naivety about computing generally, allied to continual press and TV bombardment about the micro revolution, will lead some users to seek their own solutions which can be expensive to the company as a whole. The establishment and promotion of a professional microcomputer service by DP departments will go a long way towards ensuring that the optimum use is made of microcomputer technology. DP departments should be aware that many user managers will have budget authority to spend the capital sums to acquire a micro, as will engineers, technicians and scientists. It will not usually be possible for DP to establish a monopoly on micro supply and application. However, the need for advice and support services from DP will grow and an increase in user independence should encourage healthy mutual respect. It is vital that DP gears up to provide a rapid response to user needs, especially through purchase of turnkey systems. Response times normally associated with mainframe systems (six to 18 months) will frustrate users further and understandably encourage them to seek satisfaction elsewhere.

3. Software and services: While hardware costs continue to fall, manpower costs are rising with inflation. Increasingly, software development and services will represent the highest cost in a total system. But the naive user does not understand software and relates cost to hardware prices. In microcomputing, software and associated services are rarely less than the hardware and frequently three times more than the hardware cost. It is vital to tap available expertise, using good development aids and packages wherever possible. Computer departments have a very important role to play in protecting users and the company from making expensive software mistakes.

4. Security of suppliers: The micro industry is young and volatile. The first microcomputers came on the market in 1975. Some companies have become established in sectors of the market, a few have come and gone already. There is no one dominant manufacturer: no IBM or DEC. However, there is much more software and hardware conformity in microcomputing than in mainframe and mini computing because the industry is a component industry. The common international hardware and software standards should be adopted. They will provide independence from any one supplier and give a wide range of choice in products.

5. Maintenance and day-to-day operation: In looking at any new development in computing, the promise of the technology frequently overshadows the more mundane but vital aspect of reliability, maintenance and day-to-day operation. DP departments are well equipped to advise their users on the importance of these aspects since they apply equally in microcomputing as to mainframe and minis. An important element in choosing equipment is the availability of maintenance and spare parts. Equipment which is supported under complete system maintenance contracts by established companies is advised.

6. Component industry: As already mentioned, the microcomputer industry is predominantly a component industry. This has developed partly by chance and partly by necessity. Most of the manufacturers started off in a small way. Some significant companies today, e.g. Apple, started in someone's garage only a few years ago. Many were hobbyists and technicians who obtained relatively modest private

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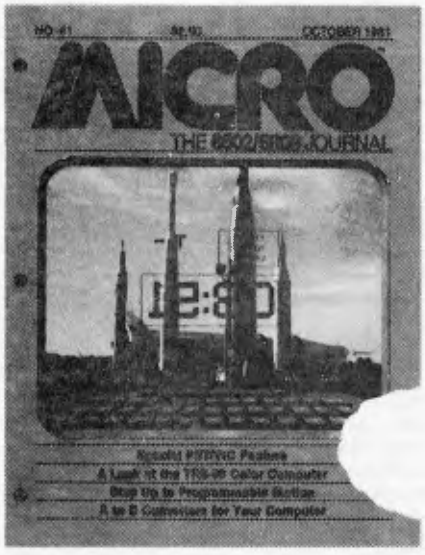

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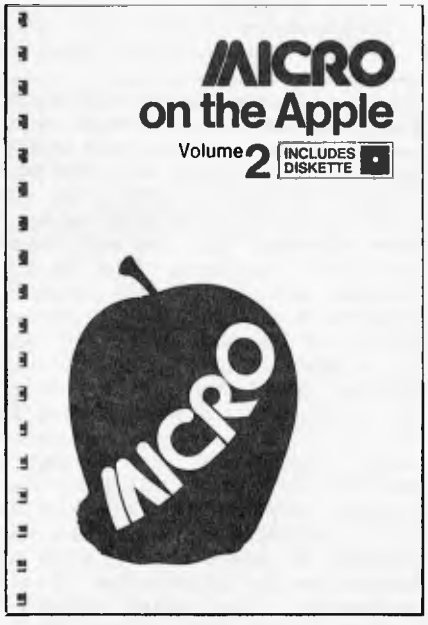

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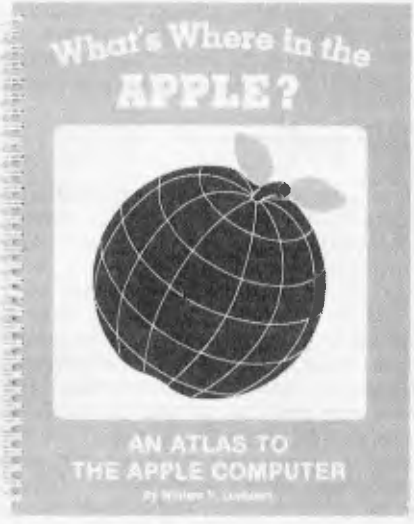

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financial backing to produce specialist printed circuit boards. Other private companies went into business putting these boards together to form microcomputers. Even at chip level, it is a component industry with board manufacturers using a selection of chips from a variety of manufacturers. Through necessity, hardware standards developed and the industry is growing into adulthood. The flexibility, robustness and economies of scale resulting from a component industry with good hardware standards has resulted in a healthy industry in which non-component companies are less competitive. Micro companies are still relatively small and some will undoubtedly go out of business. When selecting microcomputers it is therefore essential to carefully consider the financial standing and reputation of the manufacturer. It is also necessary to buy in expertise because front-line support is limited in comparison with that provided by mainframe and mini manufacturers.

7. Communications and policy for convergence: Communication is a subject frequently raised in the same breath as microcomputing, especially in large companies with dispersed computing facilities. Today it is practical to use a microcomputer as a terminal and to transfer files from one microcomputer to another. A number of communications software manufacturers have emerged and IBM 2780/3780 and 3270 protocols are generally available to turn Z80 microcomputers into very cheap emulators. Emulation software for other popular machines is arriving on the market, and some users will develop their own emulators for distributed micro systems with mainframe connections. However, microcomputers are justified most frequently as linkless terminals where communication is not required or where a postal floppy disk service is perfectly adequate. There is a growing demand for a means of interconnecting not simply micros and minis but other devices, e.g. word processors, photosetters and viewdata services. It is important that the impact of these demands on existing communication networks is considered and a strategy to meet future requirements established.

8. Future technologies: Microcomputer technology is changing rapidly. Companies will often wish to take advantage of the latest technology but should be careful about pioneering new products in operational systems. Continuously keeping near the forefront of technology can be costly if it means replacing equipment every year and expanding the range of supported systems. It is possible to adopt new technologies inexpensively by using relatively well-proven products. The position of microcomputing a year ago was that there were proven, operational, single-user systems performing calculations and data processing tasks. Today there are proven multi-user systems with substantial cheap storage and communications capability. In a year's time proven technology will be available to facilitate the convergence of disparate computer architecture and the exchange of data between many different devices. The gateway to these technologies is in standard software, CP/M, MP/M, Unix, MBasic, CIS-Cobol and Pascal — a point that is repeated to ensure that the software media is the message.

Provided they are identified as prototypes, a valuable contribution can be made from experimental systems, and large departments should have a research and development budget to test new products. Communication and convergence products can be taken on now in controlled experiments which can add considerably to subsequent computing capability and economics.

Summary of possibilities

A later chapter explores the applications for the general-purpose microcomputer but a summary at this stage will help put this powerful and versatile machine into the context of existing computer resources and constraints.

1. Options to mainframe systems.
- Low priority systems: Systems not economically justified on mainframes and/or those that never appear high enough on the priority list to be implemented.
- Replacement of creaking systems that need major overhaul.
- Low data volume systems. Systems with file sizes from 100k to 100Mb.
- Terminal systems with stand-alone capability. Sytems primarily used for local processing with occasional need to access/update mainframe files.
- Extensions of big systems to lower levels in the company, eg, depot stock recording.

2. Options to minicomputer systems.
- Similar options to mainframe systems.
- More affordable 'minicomputer'. Systems with 2-16 users.
- Local area network alternative to multi-user minis.

3. Options to timesharing systems
- Replacement of numeric applications, financial planning, PERT.
- Replacement of lower data volume systems.
- Use as data entry devices to cut connect costs.
- Terminal systems with stand-alone capability.
- Local area network with timesharing capability.

4. Options to word processing and other systems.
- Alternative to dedicated word processors.
- Suited to combined data processing and word processing applications.
- Alternative to dedicated viewdata terminals.
- Local area networks with electronic mail capability.

5. Relevance of existing expertise.
- User timesharing skills apply, eg, Basic, APL, Fortran.
- DP development skills apply, eg, ANSI Cobol availability.

The third commandment of microcomputing

Thou shalt not be inhibited by the limitations of today's microcomputers. Even as they are being discussed, the inadequacies of the current generation of microcomputers are being made good in subsequent generations. The summary of possibilities describes some options created by today's 8-bit and 16-bit machines. The emergence of commercially available 32-bit devices in two years' time will dramatically enhance the application of micro technology, especially as it combines with new video, communications and storage technologies. Companies planning a five-year computing strategy must be aware of those possibilities and make decisions that will provide a pathway from 8-bit to 16-bit to 32-bit machines. It is essential for management to investigate developments in the different fields of computing.

Management service executives should spend several weeks in the USA visiting leading semiconductor, mainframe, mini, micro, peripheral, communication system and software suppliers. Such a trip will be a revelation: no words can have the impact of actually seeing the new products that the microchip is siring. The sophistication of the products and the speed with which factories mushroom to produce them is stunning even for those close to the technology.

TJ's WORKSHOP

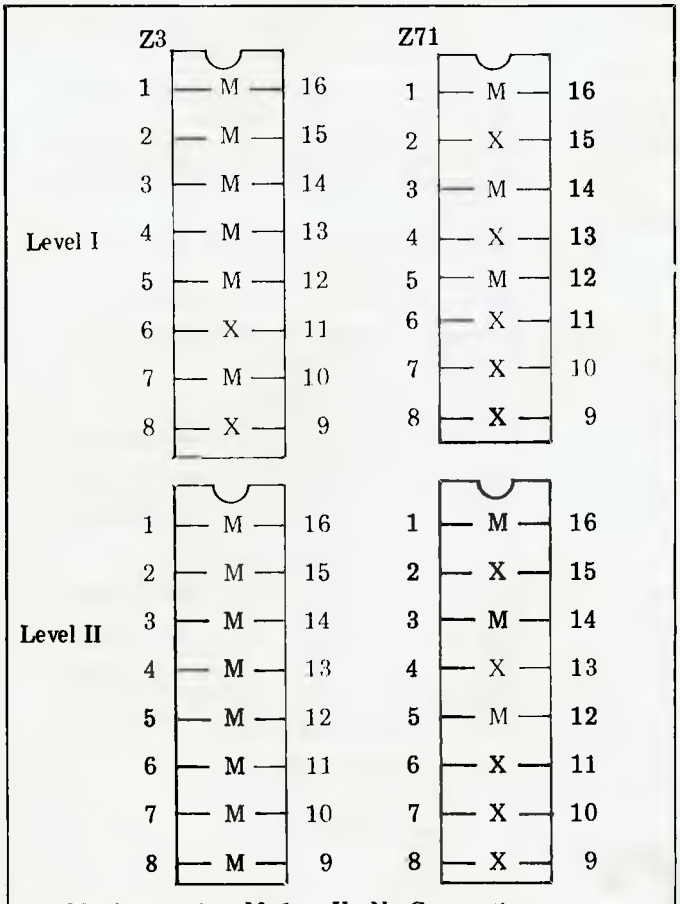
Our monthly pot-pourri of hardware and software tips for the popular micros. If you have a favourite tip to pass on, send it to: 'TJ's Workshop', APC, 462 Burwood Road, Hawthorn, 3122. Please keep your contributions as concise as possible. We will pay $10 for any tips we publish (think how much solder and/or sticky tape that would buy).

TRS-80 4k TO 16k UPGRADE

One of the most overpriced items in computing at present must be the 'official' Tandy 4k to 16k keyboard memory upgrade for the TRS-80 Model I which costs approximately $250 at any Tandy store. Following the instructions below, the expansion can be completed, without soldering, for a cost of approximately $20 to $24. The parts required are:
8 x 4116, 200 ns memory chips
2 x 8 way DIL switches

The expansion is carried out as follows:
1. Ensure that the power is turned off, and remove all cables from the back of the TRS-80. Turn the keyboard upside down and remove the six screws, noting their different sizes to enable correct re-assembly. (NB: The removal of these screws will void the Tandy 90 day warranty.)
2. Find the eight chips, which are socketed, and identified as Z13 to Z20 on the circuit board. Before these chips are removed, note the position of the notch at the end to ensure that the eight new chips are inserted the correct way around. Remove the old chips and insert the new ones, taking care not to bend any of the pins.
3. To enable the computer to recognise the new memory, changes must be made to the programming of the two DIP shunts located at Z3 and Z71 on the circuit board (they are clearly marked). Looking at the circuit board with the reset switch at the top right, the two DIP shunts should be removed and replaced with the DIL switches, programmed as shown in the diagram.
4. After double-checking that there are no bent pins on the newly inserted chips; and that Z3 and Z71 are correctly programmed, replace the back of the TRS-80 keyboard, connect the cables, and turn on the power. Type "PRINT MEM" in command mode. The reply should be 15572 if you have an old ROM level II (MEMORY SIZE?) CPU like mine. I believe that the reply should be 15570 for the new ROM level II (MEM SIZE?) and 15871 if you have a level I machine.

L. Trigg



16k Dip-switch programming

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D(elete)	> Deletes rows or columns.
E(dit)	> Allows editing of a cell.
F(ormat)	> Changes format: cells, rows, entire worksheet.
G(lobal)	> Makes one command universal.
I(nsert)	> Creates new row or column.
L(oad)	> Reads all or part of worksheet from disk.
M(ove)	> Swaps rows or columns.
O(utput)	> Displays or prints reports.
P(rotect)	> Prevents future alteration of cells.
Q(uit)	> Exits SuperCalc.
R(eplicate)	> Reproduces parts of rows or columns.
S(ave)	> Stores worksheet on disk.
T(itle)	> Locks first rows or columns in place.
U(nprotect)	> Allows changes in protected cells.
W(indow)	> Splits or unsplits the screen.
Z(ap)	> Clears worksheet.

NUMBER FORMATS AVAILABLE

*	Graphic data.
G	General type numeric format.
E	Scientific notation.
$	Dollars.
I	Integer.
TR	Text right.
TL	Text left.
R	Right.
L	Left.

ZX81 TIPS 1

Machine code users might like to know that you *can* reset RAMTOP without clearing the memory (useful if you suddenly remember you haven't reserved enough space). Method is as follows: POKE desired value for RAMTOP into 16388 and 9; PRINT USR 1040. It's as simple as that. Any Basic program remains unaffected, though variables are cleared.

Replace bulky IF statements used to control printing with one line as follows:

```
10 IF X=1 THEN PRINT 'YES'
20 IF X=0 THEN PRINT 'NO'
30 IF Y=D THEN PRINT 'FALSE'
40 IF S<>F THEN PRINT 'TRUE'
```

becomes:

```
10 PRINT 'YES' AND (X=1);
   'NO' AND (X=0),, 'FALSE' AND
   (Y=D0,, 'TRUE' AND (S<>F)
```

Unfortunately, even if the third condition is not fulfilled the two commas are still acted upon, so you have to watch line spacing. This can be a terrific memory saving.

Why not structured Basic on a ZX81? Simply identify program areas with REM statements (you do anyway, don't you?), giving each area a name. Declare that name as a variable at the beginning of the program with a value equal to the line number following the REM statement in which it occurs. Then, in your GOTOs, specify the variable name. This also makes simple renumbering routines which cannot cope with GOTOs more useful. After renumbering the lines you have only to check the REM statements to see what new values have to be assigned to the variables; no need to keep a record of where lines specified by GOTOs have been moved to. An end to incomprehensible GOTOs?

David Lawrence

ZX81 TIPS 2

I have noticed a few useful features of the ZX81 logical operator set. In addition to the standard functions (AND, OR, NOT), relational operators are valid boolean operators. This is because the logical result of a comparison is one or zero, instead of true and false, ie, PRINT A=B is a valid expression. This has useful implications when modelling combinational logic systems.

ZX logic is defined in Figure 1.

Care must be taken when mixing arithmetic operators (+,*) with standard logical operators (AND, OR, NOT) as the latter have much lower priority when the expression is evaluated, so application of brackets is essential. In fact, the only use for AND and OR as standard functions is the mixed type expression, ie, A$AND B will return string A$ if A is true. Full truth tables for a switching function can easily be generated thus as in Figure 2. (note I=one):

Try expression
A< >(B< >(C< >D)) — 4-bit parity generation!

David Davies

Figure 1

ZX notation	Boolean expression		
A<B	$\overline{A}.B$	(NOT A) AND B	
A>B	$A.\overline{B}$	(A AND (NOT B)	
A<=B	$\overline{A}+B$	(NOT A) OR B	
A>=B	$A+\overline{B}$	A OR (NOT B)	
A<>B	$A \oplus B$	A EXOR B	
A=B	$\overline{A \oplus B}$	A EXNOR B	
A*B	A.B	A AND B	Arithmetic operators work too!
A+B	A+B	A OR B	

Figure 2

```
100 FOR A=0 TO 1
110 FOR B=0 TO 1
120 FOR C=0 TO 1
 "   "   "
260 FOR Z=0 TO 1
270 PRINT A;B;C;...Z;"="; (SOME EXPRESSION.)
280 NEXT Z
290 NEXT Y
 "   "   "
530 NEXT A
```

EPROM PROGRAMMER FOR PET

An EPROM programmer is out of my price range, especially when I only want an occasional 2716 programmed; also as a hobbyist felt I should do as much as possible myself, even if it took a long time — that's part of the enjoyment.

The current 'standard' EPROM is the 2716: it costs around $10 , but will doubtless cost half that by the time this article is published. It holds 2048 bytes of memory. It has 11 address pins, eight data pins and five others:

Vcc : 5 volts
Ground : 0 volts
Vpp: 26 volts when programming, 0 or 5 volts when reading
OE : needs Vcc when programming, 0 volts when reading
CE/PGM : requires a 50 millisec pulse of Vcc when programming and 0 volts enables the 2716 when reading.

To program the first address of the EPROM we do the following:

1 apply 25 volts to pin 21 (Vpp);
2 apply 5 volts to pin 20(OE);
3 apply the address to the address pins (1—8, 22—23 & 19);
4 apply the data required to the data pins (9—11 and 13—16);
5 apply a 50 millisec TTL high-level pulse to pin 18. (CE/PGM).

To program the next memory we now increment the address in 3 above, change the data, and then send another program pulse.

When all 2048 bytes of data have been programmed, we switch off the 5 volts to pin 18 and then the 25 volts to pin 21. It is important to do the switching in this order. Vpp should only be switched when CE is at ground potential. It is also important that the program pulse be fairly accurate. If it exceeds 55 millisecs damage will almost certainly be done to the EPROM.

Of the PET's output ports the Parallel User Port (PUP) is the most useful. It has the data bus available — for both input and output — and the CB2 output for control. I wanted two other outputs so I spent some time studying the IEEE port. In the past I have treated this with great suspicion, but after some experimentation (not to mention several frustrating crashes) I obtained two outputs that could be programmed fairly easily. These were from pins 6 and 8 (DAV and NDAC), which can be addressed in machine code within $E821 and $E823.

The provision of addresses for the 2716 is straightforward. Three SN749s will give 12 addresses — one more than needed — with only two inputs to think about: one to zero the counters and another to increment them one at a time.

Basic is too slow and unreliable for times as short as 50 millisecs so the programming and checking of the EPROM is done entirely with machine code. The Basic program (shown in Figure 1) which leads to it is merely a print-out program which slows me down, forcing a 'Y E S' from me when I have done various things in the right order. The machine-code program is shown in Figure 2.

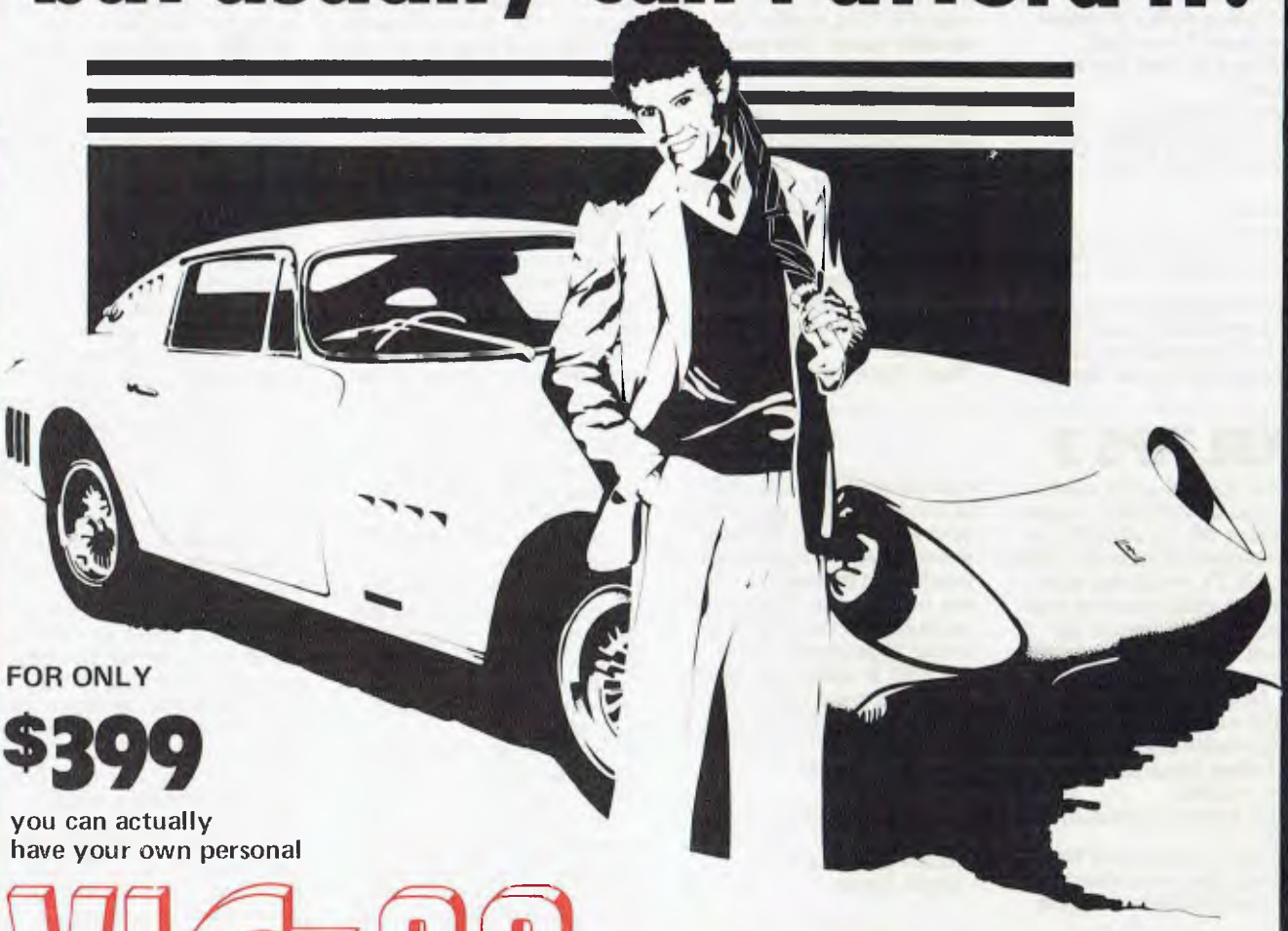
During the programming of the 2716 there is a need for four states. A SN7474 is used to latch these states according to the following truth table:

Figure 1

```
LIST
  100 PRINT"2716 EPROMMER"
  110 PRINT"-------------"
  120 PRINT"MEMORY FOR ROM MUST BE PLACED BETWEEN"
  130 PRINT"$CC00 AND $13FF BEFORE RUNNING THIS"
  140 PRINT"PROGRAM ANY FURTHER.  IF THIS IS OK"
  150 PRINT"PLEASE WRITE";CHR$(34);"Y E S";CHR$(34);".":GOSUB2000
  160 PRINT"PIN 20 (OE) SHOULD NOW BE AT 0 VOLTS"
  170 PRINT"AGREE? (Y E S)":GOSUB2000
  180 PRINT"PLEASE APPLY 25 VOLTS TO PIN 21(VPP)"
  190 PRINT"DONE? (YES)":GOSUB2000
  200 PRINT"PLEASE APPLY 5 VOLTS TO PIN 20(OE)"
  210 PRINT"DONE? (YES)":GOSUB2000
  220 PRINT"FINAL CHECK.  IS EVERYTHING NOW READY"
  230 PRINT"FOR PROGRAMMING?":GOSUB2000
  240 PRINT"THE EPROM IS NOW BEING PROGRAMMED.":SYS2688:REM 2688=$0A80
  250 PRINT"PLEASE APPLY 0 VOLTS TO PIN 20(OE)"
  260 PRINT"DONE? (YES)":GOSUB2000
  270 PRINT"IF OE IS NOW AT ZERO PLEASE APPLY 0"
  280 PRINT"VOLTS TO PIN 21(VPP)":PRINT"DONE? (YES)":GOSUB2000
  290 E=0:PRINT"EPROM IS NOW BEING CHECKED.":SYS2853:REM 2853=$0B25
  300 IF PEEK(2880)=0 AND PEEK(2881)=20 THEN360:REM 2880=$0B40
  310 F=PEEK(2924)+PEEK(2881)*256:G=255-PEEK(59471):REM 2924=$0B6C
  320 PRINT"ERROR";F;"SHOULD BE";PEEK(F);"BUT IS";G
  330 E=E+1
  340 SYS2920:REM 2920=$0B68
  350 GOTO300
  360 PRINT"THE EPROM HAS NOW BEEN CHECKED.  THERE WERE";E;"ERRORS."
  370 END

 2000 INPUTA$:IFA$<>"YES"THEN2000
 2010 RETURN
```

For the person who would like everything.... but usually can't afford it!



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Latch A	Latch B	
0	0	No action
1	1	Clear the 7493s
0	1	Clock the 7493s
1	0	Send program pulse

Table 1 Memory map for the 2716 Eprommer

$0400 — $09FF : Basic program
$0A80 — $0B24 : M/Code for programming
$0B25 — $0B70 : M/Code for checking
$0C00 — $13FF : Data for transfer
$16F6 — $1FFF : Reserved for monitor

The various programs are contained in the PET's 8k memory according to the memory map in Table 1. The monitor program at the top of memory is SUPERMON — an exremely useful piece of software used for checking everything — and which now is part of an EPROM between A000 and AFFF. The program takes just under two minutes to transfer the full 2048 bytes.

The SYS instruction in line 240 of the Basic program puts us into the machine-code program, which starts at $0A80. This uses several sub-routines which are as follows:

ZERO ($0AC0) — this puts A and B to logic '0';

CLEAR ($0AD0) — puts A and B to logic '1' to produce a '1' from an AND gate to clear the 7493s;

CLOCK ($0AE0) — puts latch A to '0' and B to '1'. This produces a clock pulse to input A of the first SN7493 counter;

PULSE ($0AFC) — puts A to '1' and B to '0'. After the jump to LATCH the program pulse will start;

LATCH ($0B00) — this clocks both latches. Whatever was present on the D input is now transferred to the Q outputs;

DELAY ($0B10) — A delay sub-routine of 50 milliseconds.

The 7493s are cleared by $0A87 to make all 11 addresses of the 2716 logic '0'. $0A8A — $0A8E makes the PUP available for outputting data and then registers X and Y are set to count 2048 bytes.

The program (which has been previously loaded into the area between $0C00 and $13FF) is now, one byte at a time, loaded into the accumulator at $0A9D and transferred to the PUP at $0AA4.

With the address and data now held at the 2716 inputs, we now send the 50 millisecond program pulse. The clock sub-routine at $0AAD stops the program pulse and we then load the next byte of data. When both the Y and X registers are finally zero we return to the Basic program, with instructions for switching OE and Vpp appearing on the screen.

The checking program now starts. The 7493s are again cleared and as we increment through their addresses we check that the memory in RAM coincides with its equivalent in the ROM. Any fail ures cause the appropriate error message to appear on the screen.

It is not necessary to program all 2 kilobytes at any one time. By altering the LDY at $0A99 and the LDAs at $0A90 and $0A9F you can program fewer amounts of 256 bytes, or start programming from a higher address than $0C00.

When the 2716 is new (or newly-erased) it is full of '1's (16,384 of them). It is programmed by converting some of these '1's to '0's. It is therefore important that all locations between $0C00 and $13FF, other than those which contain data to be transferred, contain $FF.

Programming mistakes are fairly easily rectified with the help of a sun-ray lamp if you don't have access to a proper eraser. 25 minutes within 3in of a glowing ultra-violet bulb make the EPROM as good as new. But be careful which way round you insert the chip — the sun-ray lamp doesn't correct for 25 volt mistakes! You will find that Data 1 on pin 9 doesn't read '0's ever again if you try to program the 2716 with it inserted back to front.

ICs 7 and 8 are 8T26s which invert the data when both programming and check-ing. The EOR #$FF at $0AA0 inverts the data before it leaves the PET and another inversion occurs at $0B42 when checking the data. If 8T28s are used these should be amended accordingly.

The circuit diagram of the device is shown at Figure 3.

J D Beaven

Figure 2

```
                0AC0 EA         NOP
                0AC1 EA         NOP
                0AC2 EA         NOP
                0AC3 78         SEI
                0AC4 20 C0 0A   JSR ZERO
                0AC7 20 D0 0A   JSR CLEAR
                0ACA A9 FF      LDA #$FF
                0ACC 8D 43 EA   STA $EA43
                0ACF A9 0C      LDA #$0C
                0AD1 8D 9F 0A   STA MEMRY+2
                0AD4 A9 00      LDA #$00
                0AD6 8D 9E 0A   STA MEMRY+1
                0AD9 A0 08      LDY #$08
                0ADB A2 00      LDX #$00
MEMRY           0ADD BD 00 0C   LDA $0C00,X
                0AE0 49 FF      EOR #$FF
                0AE2 EA         NOP
                0AE3 EA         NOP
                0AE4 8D 4F EA   STA $EA4F
                0AE7 20 F0 0A   JSR PULSE
                0AEA 20 10 0B   JSR DELAY
                0AED 20 E0 0A   JSR CLOCK
                0AF0 E8         INX
                0AF1 D0 EA      BNE MEMRY
                0AF3 EE 9F 0A   INC MEMRY+2
                0AF6 88         DEY
                0AF7 D0 E4      BNE MEMRY
                0AF9 20 C0 0A   JSR ZERO
                0AFC 58         CLI
                0AFD 60         RTS

ZERO            0AC0 A9 84      LDA #$84
                0AC2 8D 21 EA   STA $EA21
                0AC5 A9 84      LDA #$84
                0AC7 8D 23 EA   STA $EA23
                0ACA 20 00 0B   JSR $B000
                0ACD 60         RTS

CLEAR           0AD0 A9 BC      LDA #$BC
                0AD2 8D 21 EA   STA $EA21
                0AD5 A9 BC      LDA #$BC
                0AD7 8D 23 EA   STA $EA23
                0ADA 20 00 0B   JSR LATCH
                0ADD 60         RTS

CLOCK           0AE0 A9 BC      LDA #$BC
                0AE2 8D 21 EA   STA $EA21
                0AE5 A9 B4      LDA #$B4
                0AE7 8D 23 EA   STA $EA23
                0AEA 20 00 0B   JSR LATCH
                0AED 60         RTS

PULSE           0AF0 A9 B4      LDA #$B4
                0AF2 8D 21 EA   STA $EA21
                0AF5 A9 BC      LDA #$BC
                0AF7 8D 23 EA   STA $EA23
                0AFA 20 00 0B   JSR LATCH
                0AFD 60         RTS

LATCH           0B00 A9 1E      LDA #$1E
                0B02 8D 4C EA   STA $EA4C
                0B05 A9 CC      LDA #$CC
                0B07 8D 4C EA   STA $EA4C
                0B0A 60         RTS

DELAY           0B10 A9 FF      LDA #$FF
                0B12 8D 0F 0B   STA DELY2
LOOP2           0B15 A9 15      LDA #$15
                0B17 8D 0E 0B   STA DELY1
LOOP1           0B1A CE 0E 0B   DEC DELY1
                0B1D D0 FB      BNE LOOP1
                0B1F CE 0F 0B   DEC DELY2
                0B22 D0 F1      BNE LOOP2
                0B24 60         RTS

CHECK           0B25 78         SEI
                0B26 20 00 0A   JSR CLEAR
                0B29 A9 00      LDA #$00
                0B2B 8D 43 EA   STA $EA43
                0B2E A9 0C      LDA #$0C
                0B30 8D 41 0B   STA MEMEX+2
                0B33 A9 00      LDA #$00
                0B35 8D 40 0B   STA MEMEX+1
                0B38 A0 08      LDY #$08
                0B3A A2 00      LDX #$00
NEXTD           0B3C 20 C0 0A   JSR ZERO
MEMEX           0B3F BD 00 0C   LDA $0C00,X
                0B42 49 FF      EOR #$FF
                0B44 CD 4F EA   CMP $EA4F
                0B47 D0 16      BNE ERROR
                0B49 20 E0 0A   JSR CLOCK
                0B4C E8         INX
                0B4D D0 ED      BNE NEXTD
                0B4F EE 41 0B   INC MEMEX+2
                0B52 88         DEY
                0B53 D0 E7      BNE NEXTD
                0B55 20 C0 0A   JSR ZERO
                0B58 A9 FF      LDA #$FF
                0B5A 8D 43 EA   STA $EA43
                0B5D 60         RTS

ERROR           0B5E 8A         TXA
                0B5F 8D 6C 0B   STA REGX+1
                0B62 98         TYA
                0B63 8D 69 0B   STA REGY+1
                0B66 60         RTS
REGY            0B67 A9 00      LDA #$00
                0B69 A8         TAY
REGX            0B6A A9 00      LDA #$00
                0B6C AA         TAX
                0B6D 4C 49 0B   JMP $0B49
```

Table 2

```
RUN
2716 EPROMMER

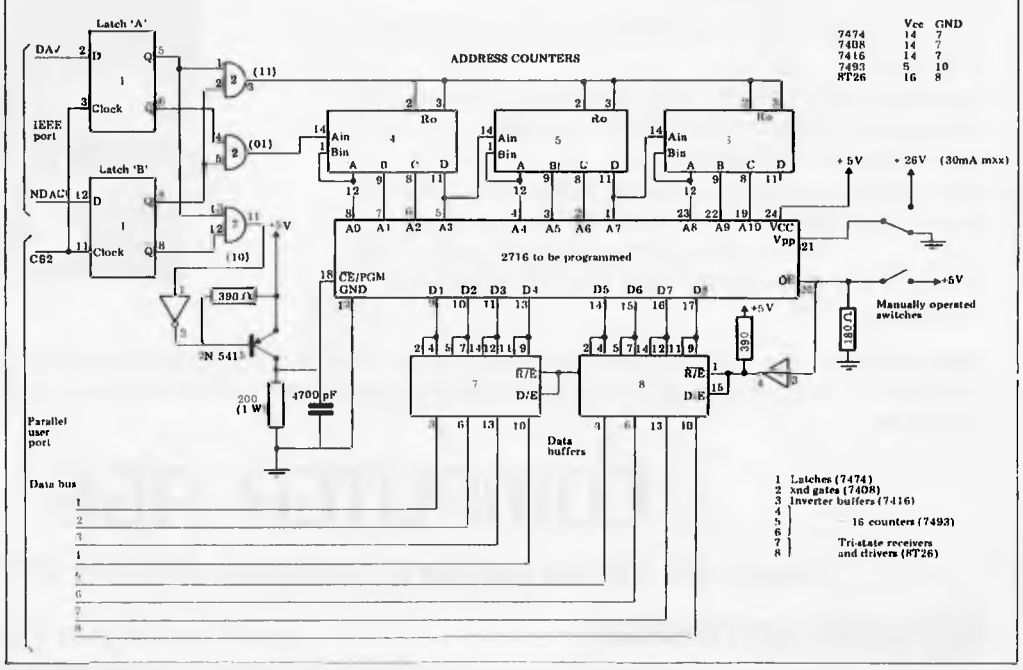
MEMORY FOR ROM MUST BE PLACED BETWEEN
$0C00 AND $13FF BEFORE RUNNING THIS
PROGRAM ANY FURTHER.  IF THIS IS OK
PLEASE WRITE "Y E S".
? YES
PIN 20 (OE) SHOULD NOW BE AT 0 VOLTS
AGREE? (Y E S)
? YES
PLEASE APPLY 25 VOLTS TO PIN 21(VPP)
DONE? (YES)
? YES
PLEASE APPLY 5 VOLTS TO PIN 20(OE)
DONE? (YES)
? YES
FINAL CHECK.  IS EVERYTHING NOW READY
FOR PROGRAMMING?
? YES
THE EPROM IS NOW BEING PROGRAMMED.


PLEASE APPLY 0 VOLTS TO PIN 20(OE)
DONE? (YES)
? YES
IF OE IS NOW AT ZERO PLEASE APPLY 0
VOLTS TO PIN 21(VPP)
DONE(YES)
? YES
EPROM IS NOW BEING CHECKED.

THE EPROM HAS NOW BEEN CHECKED.  THERE
WERE 0 ERRORS.

READY.
```

Figure 3



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TJ's WORKSHOP

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```
1 F=59408:IFPEEK(P)<>249THENPRINT"■STOP THE TAPE.
2 IFPEEK(P)<>249THEN2
10 REM TO 90 : TITLES. DESCIPTIONS OF PROGRAMS.
100 PRINT"■■PRESS '1' FOR THE FIRST PROGRAM ON TAPE.";
102 PRINT"'2' FOR THE SECOND ETC.
105 PRINT"■(NOTE: TIMINGS ARE APPROX.)■■■■■■■■■■
110 GETA$:IFA$=""THEN110
120 IFA$="2"THENK=8.5
130 IFA$="3"THENK=18
140 IFA$="4"THENK=28
195 IFVAL(A$)=0ORA$="4"THEN110
200 PRINT"■OK: ";:IFA$="1"THEN280
210 PRINT"PRESS F.FWD ON TAPE.
220 IFPEEK(P)<>233THEN220
230 TI$="000000":PRINT"■OK
240 IFTI<K*60THEN240
250 POKEK+3,60:PRINT"■STOP TAPE.
260 IFPEEK(P)<>249THEN260
270 POKEK+3,61
280 A=525:B=527:IFPEEK(5000)THENA=158:B=62
300 PRINT"■■■■LOADS":POKEA,5
310 FORT=0TO4:READT:POKEB+T,T:NEXT
320 DATA13,82,85,78,13
READY.
```

My school and I have a lot of programs for PET. It is both messy and, with lots of children around, tempting fate to keep them all on separate cassettes.

Problem: the tape unit does not have a counter. Solution: head each tape with a contents/counter program as above.

Problem: there is no easy way to work out the value of K for each program. Solution: experience!

Note that line 250 stops tape even though F. Fwd is operating. Lines 280 to 320 automatically load and run the program.

V. Russell

AERIAL COUPLING

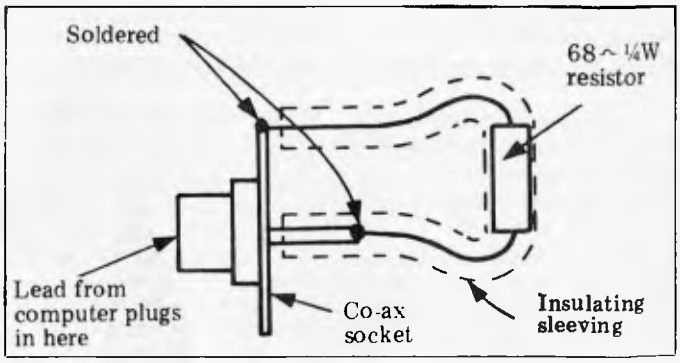
Do you find it a nuisance having to unplug the TV aerial every time you want to plug in the computer? If so, then this simple coupling unit may be of use to you. It enables the TV to pick up sufficient signal from the computer without having to disconnect the aerial.

There are two ways in which it can be used. If your set has a small box on the back to convert the round co-ax lead from the aerial into the flat twin lead which actually goes to the aerial terminals of the set (as on many Japanese sets), then tape the unit onto the twin lead with the wires of the resistor running parallel with those of the lead. If you use an indoor aerial, place the unit against the aerial. It will be necessary to experiment to find the best position. With a 'toast-rack' type aerial, hanging it from one of the rods about 1/3 of the way from the front and close to the centre line of the aerial seems quite good. In either case, if more signal is required, the leads of the resistor can be extended by up to a couple of inches each.

If you have an outside aerial, and the lead is co-ax all the way, then I am afraid that this particular unit is of no use to you.

Warnings: 1) Do not place this coupling device within the TV, or make any direct connections to the inside of the set. 2) Since the aerial is still connected, a small amount of signal could be radiated from it. This might possibly cause interference to other sets if their aerials are close to yours or if you are fed from a communal aerial system. Position the unit so that the signal induced into the aerial/aerial lead is no more than that required to stop the picture being noisy.

P. Gascoyne



ATARI EXTRA GRAPHICS MODES

One grumble about the Atari is that, although 16 colours are available, only five can be displayed on a screen at once using just Basic. Only by using machine code could this be improved to five colours per TV line. However, this article will tell you about three more modes available in Basic, one of which allows 16 colours per TV line.

At the back of the Basic Reference Manual there is a table of nine modes and screen formats. To that table you can add three more graphics modes, each having a resolution of 80 columns by 192 rows (no split screen allowed) and requiring 7900 bytes of RAM. The modes 9 to 11 interpret the display data bytes in groups of four bits, thus giving 16 possible values.

Mode 9 uses this data as a luminance value for colour in SETCOLOR register 4. Mode 11 uses that data as an actual colour value with the luminance of SETCOLOR register 4 (default lum of 6), although colour 0 is always at luminance 0. Mode 10 is more flexible. The value is used as an index to one of the nine colour registers available as shown in Table 1. For more details of mode

'Isn't that sweet! Mother says she's knitting you a floppy disk'

TJ's WORKSHOP

10, see later. To get you started with these new modes, try the program in Listing 1.

I can only speculate how these modes have remained unknown to most Atari users. All information in addition to the Basic Reference Manual, which all users have, comes from either the Technical Notes that be purchased from Atari dealers or from articles in American magazines, such as *Creative Computing* and *Byte*.

The Technical Notes, as mentioned last month, are rough drafts of internal documentation released (under duress?) by Atari. These are divided into two parts, Hardware Manual and Operating System User's Manual, The Hardware Manual is the more immediately interesting part as it reveals a lot of information about the graphics facilities built into the hardware. This includes details of how a customised chip, called ANTIC, is programmed to produce 14 different graphics modes, only nine of which are available from Basic. But the modes described above are not included in these 14, they are variations of Basic mode eight. The difference is due to the way that the display data is interpreted by another chip, called CTIA, one of whose jobs is to add the colour information to the data. This chip contains the colour registers, but it is not usual practice to access these directly but via duplicate registers maintained by the OS. These addresses are shown in Table 1.

There is no hint in the description of CTIA about the existence of modes nine to 11. That comes in the OS Manual. In the section which describes how to set up and use the screen as an input/output device, it states that there are 11 modes available but that modes 9 to 11 are only available if another chip is used in place of the CTIA. Now I believe that I had a CTIA chip as nothing I had read in the Hardware Manual or in magazines had suggested otherwise. But the Notes are dated November 1980. It seemed probable that if Atari developed a replacement for the CTIA, they would be using it in production models by now since it would not cost them any extra to produce and the Australian models must have required some rejigging anyway. So, I tried it and modes 9 and 11 were available on my 800! It was like finding another gear on a new car.

To use mode 10, you need to know the way a colour register is split up. The most significant half contains the colour number as defined in Table 9.3 in the Basic Reference Manual. The lower half contains the luminance value. Thus, to set the colour orange (2) with a luminance of 10 into colour register 2, use the Basic statement:

POKE 710,2*16+10

To conclude, Atari have been hiding their light under a bushel. These three extra graphics modes make the machines even more attractive.

N. Brooks

Register	Address	Mode 10 value
Player 0	704	0
Player 1	705	1
Player 2	706	2
Player 3	707	3
SETCOLOR 0	708	4 and 12
SETCOLOR 1	709	5 and 13
SETCOLOR 2	710	6 and 14
SETCOLOR 3	711	7 and 15
SETCOLOR 4	712	8, 9, 10 and 11

Table 1 Colour register addresses and mode 10 values

```
10 GRAPHICS 11
20 FOR J = 1 TO 39
30 FOR I = J TO 79-J STEP 2
40 COLOR I
50 PLOT I,J : PLOT I+1,J
60 NEXT I
70 NEXT J
80 T = I-2
90 FOR J = 40 TO 79
100 COLOR T
110 PLOT T,J : DRAWTO J,J
120 T = T-1
130 NEXT J
140 GOTO 140 : REM STOP WITH BREAK KEY
```

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HIGH DENSITY VDU CARD

B J Hawkins, in a two-part feature, tells how to produce a 80 x 26 display for your Z80/8080 system.

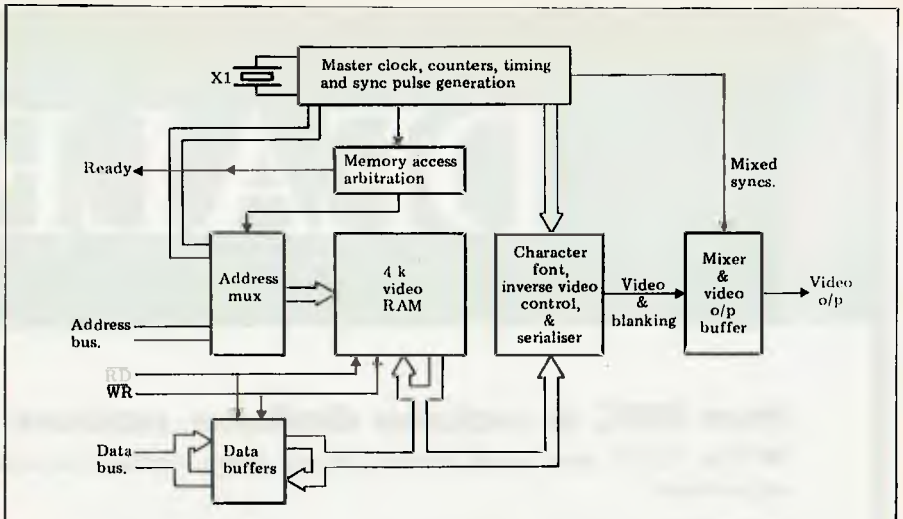

Fig 3 High-density VDU card block diagram

This article explains the principles, design and construction of a high density VDU interface card suitable for a wide range of machines and systems. Next month I'll give the assembler language driver routines to enable the VDU card to be interfaced to an 8080/8085/Z80 — based system to give a professional quality, full cursor control display screen.

Many of the single board computer systems on the market today have for reasons of economy, and so that a modulator/domestic TV may be used as the display screen, settled on a 64 character by 16 line display format. This is ideal for the apprentice programmer in terms of cost and performance but, once hooked, the serious programmer will soon outgrow this display and yearn for a professional 80 by 26 size screen. This project provides a low cost, flexible unit that, coupled with the driver routines in next month's article, will provide a professional quality display interface with the full range of standard functions but no expensive frills. My prototype was interfaced to an 8085-based system but the design is flexible enough to be used with other microprocessors, such as the 6800 or 6502. The driver routines of Part Two would, of course, require translating into the relevant machine code language.

Hardware design

The basic philosophy behind the hardware was to design a unit that meets the following broad criteria: 80 character by 26 line display format, of the memory mapped, non-interlaced raster scan type; standard composite 1V peak-to-peak video output to drive a professional monitor (approx 12 MHz bandwidth); standard low power Schottky TTL and industry standard memory devices to be used as opposed to exotic and expensive LSI chips; economy of hardware by making more complex software carry out functions such as cursor generation and control, screen scrolling and automatic carriage return and line feed; and a unit that uses standard bus signals and has non-critical timing requirements, allowing it to be coupled to a wide range of processors and systems.

A raster scan display is built up of a large number of horizontal lines traced out by the electron beam in a CRT. The scan lines start at the top right hand corner of the screen and trace out the whole area of the CRT face, ending at the bottom left-hand corner; the spot then flies back to the top right-hand corner and the process is repeated (see Figure 1). This sequence is called a field and is repeated every 1/50 second or at a repetition rate of 50 Hz. Because of the visual persistence of the phosphor of the CRT and that of the human eye, this creates the illusion of a steady picture.

To produce a video picture, therefore, certain information in the form of timing and picture data must be provided. The electron beam spot must be told when to start a horizontal scan line and when to 'flyback' to start the next scan line.

In the same way, each video field must be informed when to start and when to flyback to start the next field. And finally, of course, the electron beam intensity must be modulated along each scan line to produce picture information. These timing signals and video are combined together in set proportions to give a composite video signal (see Figure 2) and this is the signal that a CRT monitor will require to produce a steady synchronised display.

Figure 3 shows a block diagram of the main circuit areas of the high density VDU card. The video information to be displayed is held in a 4 kbyte video RAM memory. This is data in the form of ASCII character codes. The main timing generation logic in the

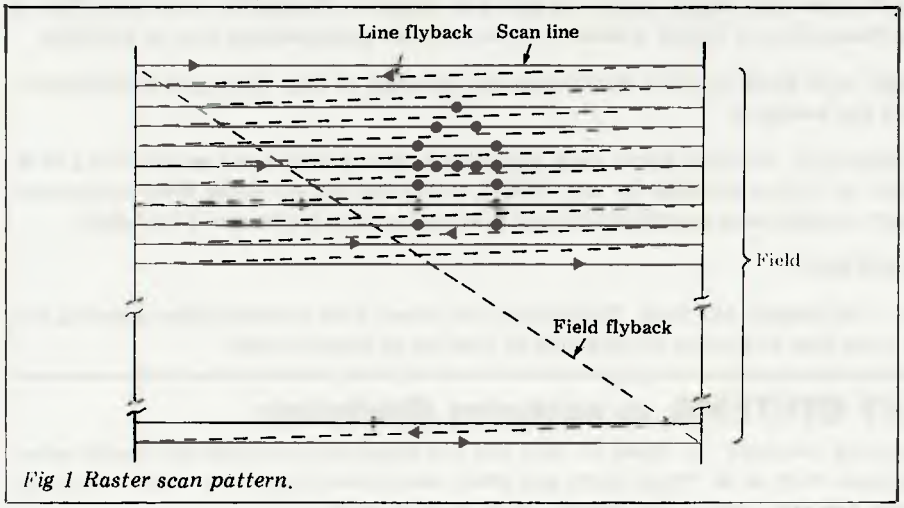

Fig 1 Raster scan pattern.

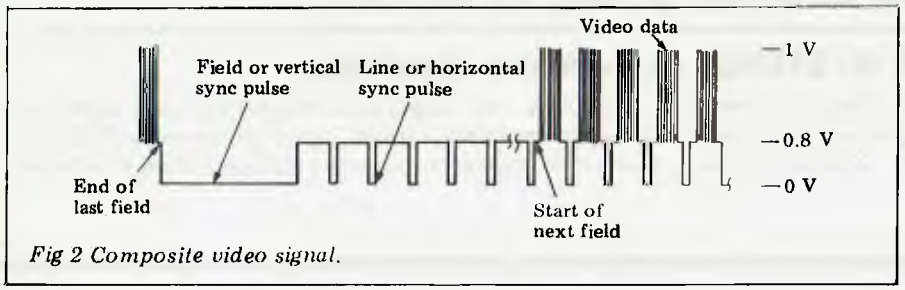

Fig 2 Composite video signal.

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U-TIM: A low-cost timer for Apple II, which can be installed in any slot except 0. Records intervals of up to one hour with a readout down to one millisecond.

U-TERM: An 80-column upper and lower case display board for slot 3 in Apple II. Compatible with Basic, Pascal and CP/M without loading from software disk. U-TERM is ideal for word-processing programmes such as Wordstar.

U-PORT: A single board with eight serial ports to allow the sending and receiving of data. Each port is individually addressable. Can be installed in any slot except 0.

U-MMS2: Memory Management System II. Removes Apple DOS from the Apple's memory and places it on a 16-K RAM card in slot 0. Memory taken up is then available for use. DOS is still active, but no longer takes up precious memory. Disk access time is reduced. Longer programmes can be run or written – programme speed increased.

U-A/D: A 12-bit A/D, digital I/O and timer.

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HIGH DENSITY VDU CARD

block above scans the video memory and synchronised to the generation of horizontal and vertical synch pulses produces at the memory output a string of consecutive ASCII code bytes. These are used by the character font block to produce the serial pattern of dots on each line needed to form the required character on the screen. The mixer and video output buffer block mixes the video data and synch pulses to produce a composite video signal of the form Figure 2.

This is how ASCII characters held in the video RAM are 'mapped' to the display screen, but of course they must be first placed there by the host system. This is accomplished by the host system writing into the 'dual port video RAM'. This may occur at any time and if this were to be allowed, it would cause the display to look unsteady and 'noisy'. To prevent this happening, the circuit block called Memory Access Arbitration controls when the host system may have access to the shared memory space. This is done by detecting when in each video field the host system may have access without upsetting the video data, ie during horizontal and vertical flyback times. During these times the logic switches over the address multiplexers so that the video memory may be addressed by the host system and data may be written or read from the memory space. If the processor of the host system should attempt to access the memory at any other time it will be placed into a 'Wait' state until the next 'flyback' time occurs. Thus the video memory may only be accessed at safe times and appears to the processor as a block of normal memory, that sometimes has a long access time. (Please note that the processor is only 'slowed down' when accessing the VDU memory and its speed is not affected when it is talking to its own system memory.)

Detailed operation

The master oscillator IC28, R1, R2, C1 and X1, uses a 12.598 MHz crystal to produce a pixel clock with a period of approximately 80 ns. Thus a pixel element, which is the smallest picture element that is displayed on the screen corresponds to 80 ns of a scan line. The basic pixel clock is divided by a factor of eight to produce a square wave character clock of 640 ns period, CHCLK, and a low going character load pulse of 80 ns every 640 ns, CHLD. Each character cell is thus composed of eight pixel elements on 11 consecutive scan lines (see Figures 4 and 5).

The character clock CHCLK is used to drive the character counter IC6 and IC8; this is a synchronous binary counter that counts from 00H to 63H (decmal 0 to 99) and is then parallel loaded by the decode produced by IC20,6 back to 00H. Thus this counter has a cycle of 64 microseconds, which is the basic line rate period required, and has seven counter output lines which give the character position on a text display line (MA0 to MA6). Flip-flop IC14 is used to produce the basic scan line rate signal HS (see Figure 6). This flip-flop is set by having a logic '1' clocked into it by a decode of the counter sequence (81 decimal) and is reset by a clear signal produced by a second decode of the counter sequence (01 decimal). (Gates IC7,8 IC20,12 IC20,6 IC11,12 IC9,3 IC4,2 and IC4,4.)

As can be seen from Figure 4, an individual cell is made up of eight pixels on 11 consecutive scan lines, hence the next step is to divide the scan line rate signal HS by 11 to produce a character line rate signal CLN. This is accomplished by counter IC10. This counter counts from zero to ten and is then parallel loaded by IC3,3 back to zero (see Figure 7). The counter output lines P0 — P3 are used to address the character look-up font to give each row of the character cell pattern.

The next step is to count the number of character text lines to give the line count addresses and the field rate signal VS. This is achieved by counter IC12 and flip-flop IC14. This is a 5-bit counter that counts from 00H to 1BH (0 to 27 decimal) and hence has a sequence length of 19.7 ms, which gives the basic 50 Hz field rate. (Gates IC13,6 IC9,8 IC9,6 IC4,8 and IC4,6.) The counter outputs MA7 to MA11 give the character text line address, and the basic field rate signal (see Figure 8) is produced from a decode of the counter output lines (gates IC11,6 and IC9,11).

This completes the description of the block of circuitry labelled as the main timing generation logic; from it the basic system clock signals and synchronisation pulses and the raster scan bus MA0 — MA11, and P0 — P3 have been produced. Now let's look at the video RAM and its associated address multiplexers.

The video RAM consists of a 4k block of 8-bit memory composed of industry standard 2114 memory chips (IC21 — 24, IC34 — 37) and the two-to-four line decoder chip IC25. The address multiplexer consists of three quad two-to-one line multiplexers IC38, IC39 and IC40. If we assume that the signal X/I SEL is high (ie internal access selected), the raster scan bus MA0 to MA11 is selected by the address multiplexers to become the video address bus VA0 to VA11. In the internal access mode, the video memory R/W signal will always be high and the RAMs will carry out read cycles only. Hence the cycling addresses on the raster scan bus will cause the video memory to produce a string of data bytes onto the video data bus. As will be explained in greater detail in the second article of this project, the memory map is not continuous; this is to economise on the number of counters used to generate the raster scan bus. This also has the effect of allowing all the software pointers and variables needed for the driver programs to be stored in non-displayed RAM areas and gives ¾k of extra continuous RAM for user programs.

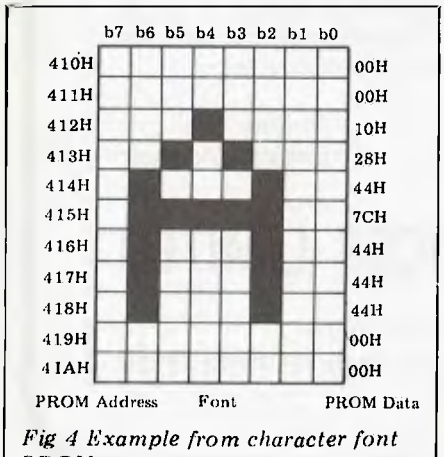


Fig 4 Example from character font PROM.

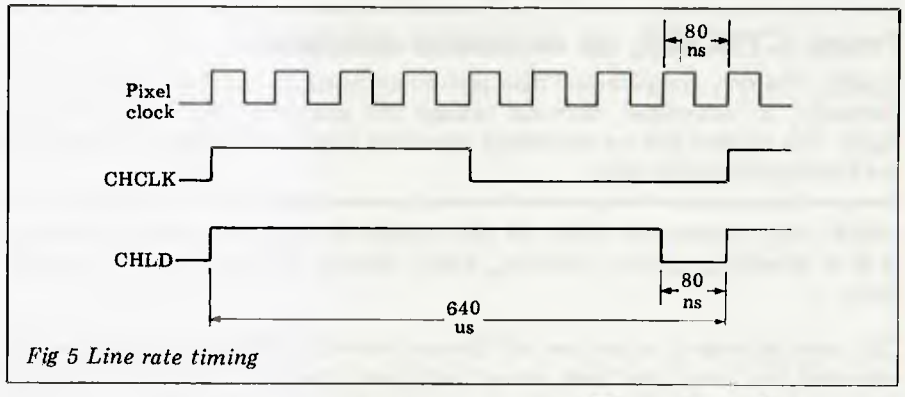
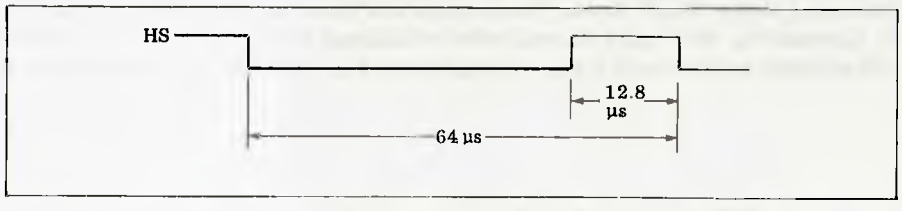


Fig 5 Line rate timing



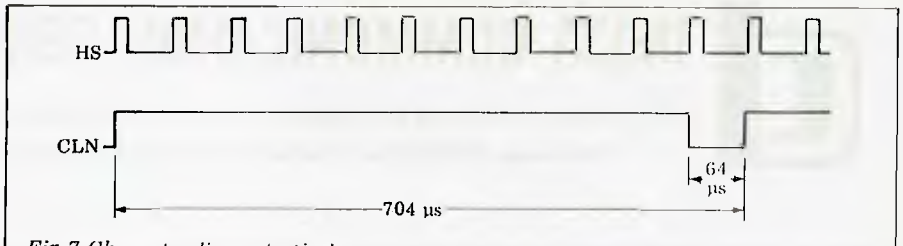


Fig 7 Character line rate timing

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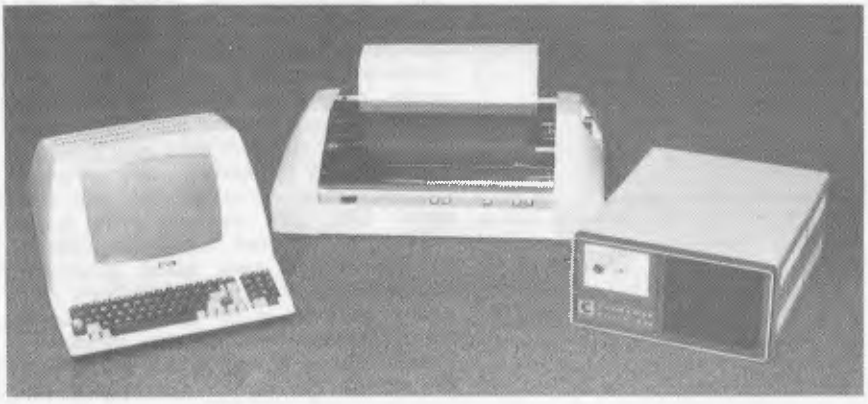

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Fig 8 Field rate timing

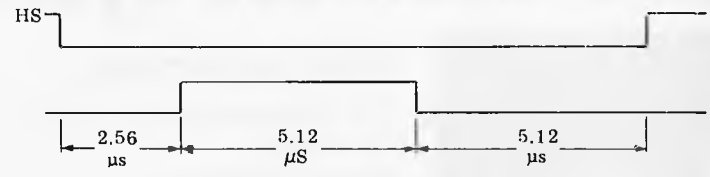

Fig 9 Horizontal sync pulse generation.

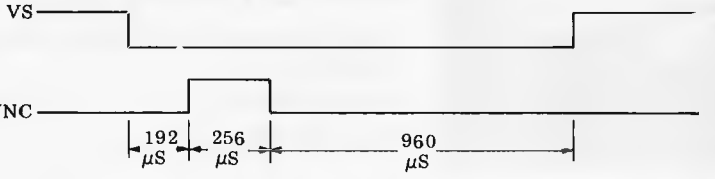

Fig 10 Vertical sync pulse generation

The string of data bytes produced by the video RAM onto the video data bus are presented in turn to the next section of circuitry that will be described, the character font and serial converter logic. ASCII data bytes on the video data bus, VID0 — VID7, are latched into the 8-bit latch IC33 by the character load pulse CHLD. The seven l.s. bits from IC33 are connected to the seven top address lines of the character font PROM IC32. This is an industry standard 2 kbyte 2716 EPROM. The character font PROM contains 128 character patterns (see Figure 4) which each consist of 16 bytes (five of which are unused); each character is selected by its 7-bit ASCII code on the top seven address bits and the required row of the pattern is selected by the scan line address bits P0 — P3. Details of the character font patterns will be given in the second article of this project. The font row data at the output of the character font PROM is latched into the parallel inputs of the serial converter shift register IC31, by the next character load pulse CHLD. This shift register is clocked by the pixel clock and produces a serial data stream from its QH output.

The m.s. output bit of IC33 is connected to the D input of the inverse video flip-flop IC19. The function of this flip-flop is to allow characters to be individually placed into the reversed video mode, ie to appear as black characters on a white or green background. Flip-flop IC19 is used to control the exclusive or gate IC18; this gate acts as a programmable inverter on the serial data stream from IC31. Thus if the msb of a byte in memory is set, the ASCII character given by the other seven bits will appear in reverse video on the display screen.

During the field and line flyback times the character font and serial converter logic will produce unwanted data that is not required to be displayed. The video data stream from IC18 is gated by IC3,8 with a signal called mixed blanking. This is produced by ORing the HS and VS timing signals together after they have been resynchronised to the character clock CHCLK (IC2 and IC30,3). Thus IC3, from its output, produces the complete video signal carrying the picture information for each scan line and blanking information during the line and field flyback times.

To produce a composite video signal (see Figure 2) we need to add line and field synchronisation pulses to the mixed video and blanking signals. To do this the signals HSYNC & VSYNC are generated (Figures 9 and 10). The horizontal sync pulse HSYNC is produced by the horizontal sync porch generator logic (IC15, IC3,6 IC4,11 and IC4,12). This circuitry produces a line sync pulse correctly framed within the line rate signal HS. The vertical sync pulse VSYNC is produced in a similar fashion by the vertical sync porch generator logic (IC16 and IC29,3). This logic produces vertical sync pulses correctly framed within the field rate signal VS. Finally the synchronisation pulses and the mixed video and blanking signals are mixed together in the correct ratio by using open collector gates and weighting resistor networks to produce a standard composite video signal (IC1,2 IC1,4 IC1,6 & R4 to R8)

The final sections of circuitry to be described are those responsible for placing display data into the video RAM at permissable times. The memory access arbitration logic produces a signal called X/ISEL; this signal determines who has access to the video RAM. When X/ISEL is high the internal raster scan bus is scanning the memory to obtain display data, when the signal is low the external system may if it is required have access to the video RAM to read or write data. X/ISEL is produced by NORing a line flyback access signal (IC19,9) and a field flyback access signal (IC17,4); these signals in each case go non-active before the 'deadline time' to allow my previously initiated external access time to be completed without the R or W cycle being 'clipped' short. The video RAM is thus available to the host system for approximately 25 per cent of the time. The other 75 per cent of the time it is being scanned by the internal logic to display data.

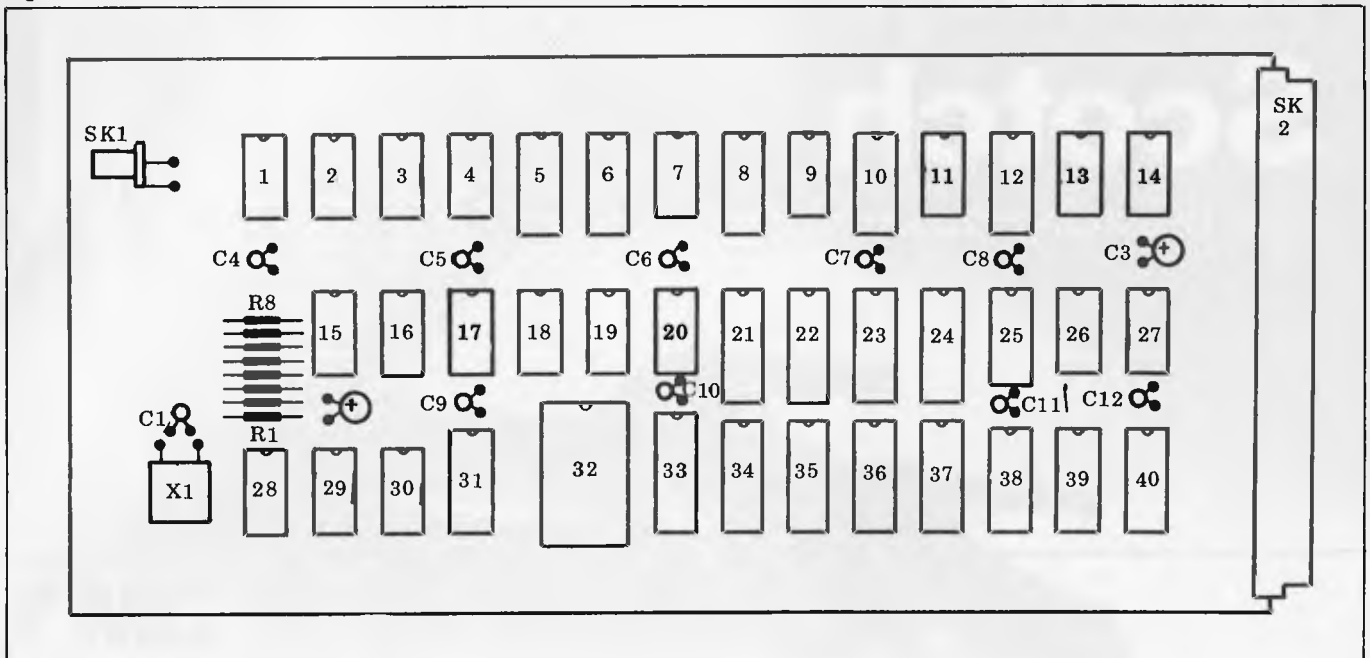

Fig 11 Suggested component layout

HIGH DENSITY VDU CARD

The access control signal X/ISEL is used for a number of purposes: first, it controls the address multiplexer to determine who is addressing the video RAM. Secondly, it qualifies the generation of Ready/Wait signals and finally it qualifies the enabling of the memory and the control of the data bus buffers. The prototype unit was designed to fit into the host system's memory map from the address F000H to FFFFH; of course, if the necessary address changes are made to the driver routines any other 4k block could be used, and the decoding of the top four address lines A12 — A15 changed to suit. When the host system attempts to access the video RAM the decode signal FxxxH will go low (IC13,8).

If the signal X/ISEL is high (ie internal access selected), this will cause the Ready/Wait line to go low forcing the processor into a wait state. When the signal X/ISEL goes low (ie external access selected) the wait signal is removed and the accesses allowed to continue as required until X/ISEL goes high again. During a read or write cycle to the video RAM the active strobe is used to enable the memory in a read or write mode and to control the data buffers to correctly input or output onto the system data bus (Gates IC3,11 IC29,8 IC30,6 IC30,8 IC17,10 IC29,11 and data buffers IC26 and IC27).

This completes the description of the high density VDU card hardware operation.

Construction

My prototype was constructed using wire wrap sockets and pins, but any suitable technique may be used as long as adequate power and ground bussing is provided. The circuitry uses a single +5V power rail at approx 1.1 amps. Figure 11 shows a suggested component layout for an extended Eurocard (220mmx100mm) matrix card, and Figure 12 gives a parts list for the project. The video output to the monitor should be kept as short as possible and a good quality monitor of at least 12 MHz bandwidth used. A modulator/TV combination will *not* have the bandwidth/resolution to give a good display.

Added features

There are a couple of extra features that could be added to the hardware quite easily: a low frequency square wave generated by further dividers from the line counters could be gated with the output of the inverse video flip-flop to allow selected characters to alternate between normal and inverse video fields; the character font PROM could be replaced by a dual-port RAM memory operating in the same way as the main video RAM (this would allow the user to load any character or graphics font required down from the host system).

IC No.	Type Number	+5V	0V	Spare gates
3	74LS00	14	7	
17	74LS02	14	7	
4	74LS04	14	7	
28	74S04	14	7	3 Inverters
1	7406	14	7	2 o.c. Inverters
9,30	74LS08	14	7	1.2 I/p And.
11	74LS10	14	7	1.3 I/p Nand.
7,13	74LS20	14	7	
20	74LS27	14	7	1.3 I/p Nor.
29	74LS32	14	7	
2,14,19	74LS74	14	7	
18	74LS86	14	7	3. 2 I/p Exclusive Or.
25	74LS139	16	8	1. 2 to 4 Line decoder
38,39,40	74LS157	16	8	
6,8,10,12	74LS161	16	8	
31	74166	16	8	
5	74S168	16	8	
26,27	74LS243	14	7	
33	74LS273	20	10	
15,16	74LS393	14	7	
21,22,23,24 34,35,36,37	2114	18	19	
32	2716	24	12	

Fig 12 IC power pins

ICs

IC1	7406
IC2,14,19	74LS74
IC3	74LS00
IC4	74LS04
IC5	74S168
IC6,8,10,12	74LS161
IC7,13	74LS20
IC9,30	74LS08
IC11	74LS10
IC15,16	74LS393
IC17	74LS02
IC18	74LS86
IC20	74LS27
IC21,22,23,23 34,35,36,37	2114
IC25	74LS139
IC26,27	74LS243
IC28	74S04
IC29	74LS32
IC31	74166
IC32	2716
IC33	74LS273
IC38,39,40	74LS157

Resistors

All ¼ W 5% tolerance.

A1,2,3	1kΩ
R4	22Ω
R5	180Ω
R6	120Ω
R7	33Ω
R8	330Ω

Capacitors

C1	0.01 µF	Ceramic
C2,3	10 µF	16v tantalum bead electrolytic
C4,5,6,7,8 9,10,11,12	0.1 µF	Ceramic

Miscellaneous

Matrix board, video connector SK1, System interface connector SK2, Wire wrap sockets for ICs, wire wrap pins, Crystal 12.598 MHz X1.

Fig 13 Parts List

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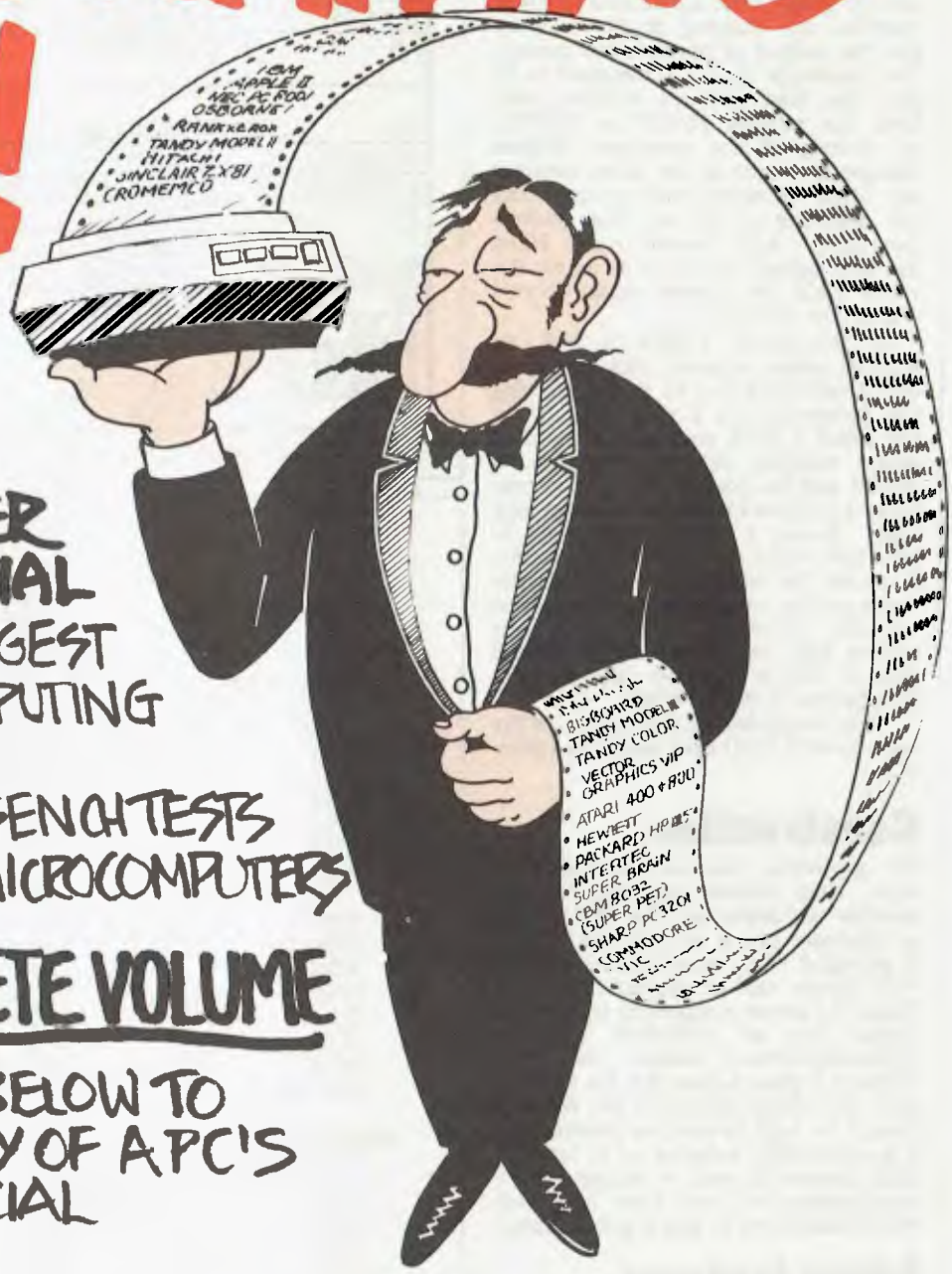

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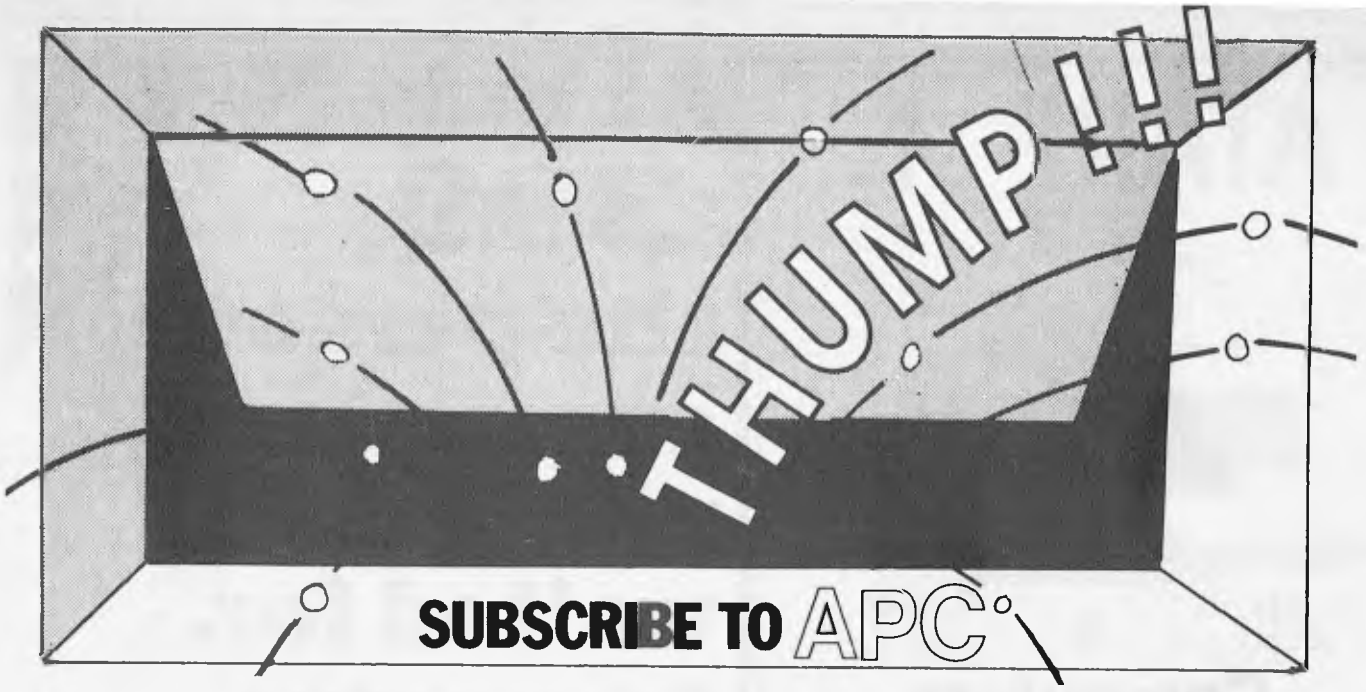

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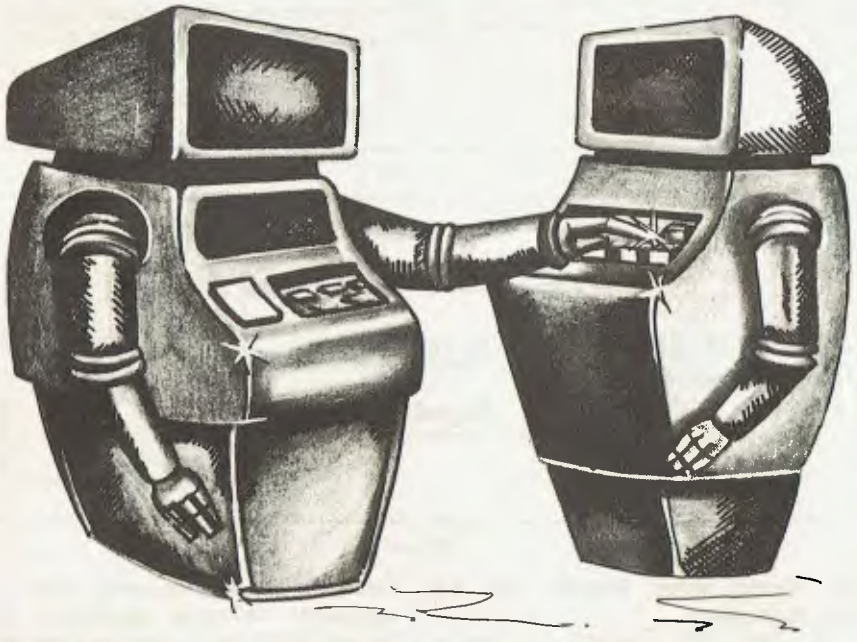


Part VI

THE UNSTANDARD INTERFACE: SERIAL I/O

by Hewlett Packard's Steve Leibson

The fact that the computer represents a relatively new technology may lead you to believe that I/O does also. The first electronic computers appeared in the 1940s, and serious work in computer data communications did not start until the next decade.

But when engineers did begin to connect computers to other devices, they used a technology that originated in the previous century – serial I/O.

ENCODING FOR MACHINES

The first electrical device used extensively for communications was the telegraph. Samuel Morse improved the telegraph mechanically, but more importantly, he devised the Morse Code. This was the first really practical encoding of the symbols humans use for communications into a machine-transmittable form.

Symbols are represented in the code by a series of dots and dashes, each character having its own unique representation. The dots and dashes may be considered the predecessors to the ones and zeros of the modern character codes we use in computer data communications.

Improvements of the telegraph led to printing telegraphs that required no human operator to decipher the codes. New codes and more advanced machines were devised, culminating in the teletypewriter.

By the time of the teletypewriter, dots and dashes had become ones and zeros. Morse code was discarded in favor of codes that assigned the same number of bits to each character. This made it much easier for machines to decode. By the time electronic computers were invented, there already existed a wealth of technology for electronic data communications.

At first, teletypewriters served as I/O devices between humans and computers. The keyboard and printer of the teletypewriter provided a low-cost data entry and display mechanism. As technology progressed, terminals and faster printers replaced the teletypewriters, but retained serial I/O interfacing.

TRANSMITTING OVER ONE WIRE

The basis for serial data communications is the transmission of information over a single wire.

Interfacing techniques previously discussed in this series have relied on several parallel wires to carry information between devices. Each wire carries a single bit of a character composed of multiple bits.

When long distances are involved, the cost of running several wires in parallel becomes prohibitive. Serial interfacing is the solution.

Time sharing was born when computers became sufficiently powerful to handle several tasks simultaneously. Since computers were still very expensive, it was necessary to spread their cost over many users.

The problem then was how to connect users at several locations to the central computer facility. Stringing wires to each location was too expensive. Fortunately, such communication lines already existed. They belonged to the phone system.

BUILDING A STANDARD

Unfortunately, these connections were not necessarily wires. They could just as easily have been satellite or land-based microwave links, since these also made up the phone system. All were designed to carry voice signals, not computer data.

In addition, phone companies were extremely unhappy at the prospect of finding all kinds of strange signals in their networks. Because teletypewriters did not have standardised interfacing requirements the voltages involved could range anywhere from 6 to 140 volts. A standard was required.

The Electronic Industries Association (EIA) standard RS-232C resulted. This standard was specifically developed to do one thing. It defines the electrical characteristics for an interface between a piece of data terminal equipment (DTE) and a piece of data communications equipment (DCE). DTE is the

terminal for the timeshare user, while DCE is a modulator-demodulator (modem) which encodes the computer data into voice-like signals that are permissible on the phone system.

Figure 1 is a picture of the wires associated with the RS-232C standard. Note that there is actually more than one wire involved. Pins 2 and 3 are the data-carrying wires, called transmitted and received data. Pin 7 is a signal ground serving as a signal current return path. These three wires are sufficient for communications between DCE and DTE.

What are all the other wires for, then? They serve as control wires between the DTE and DCE and are there merely for establishing and maintaining communications with the computer. Let's ignore them for now and examine the data wires more closely.

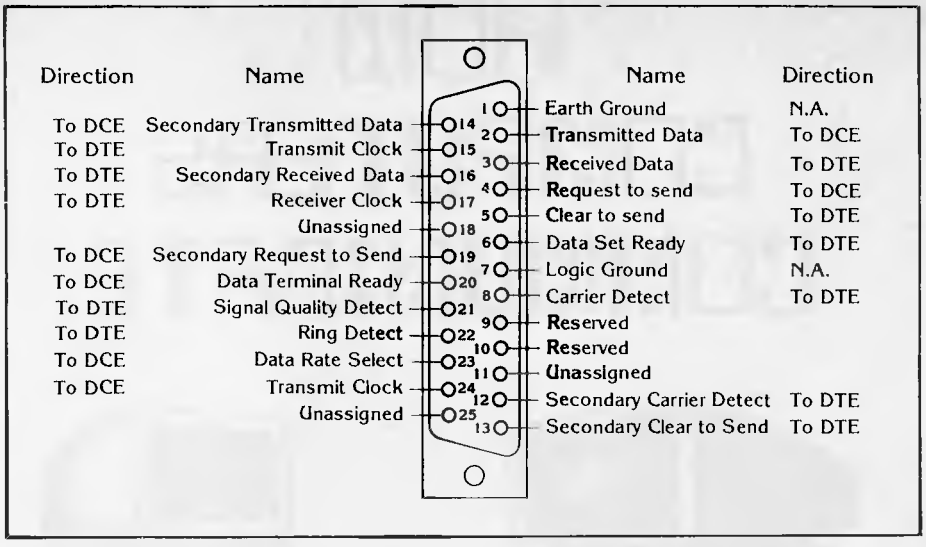


Figure 1

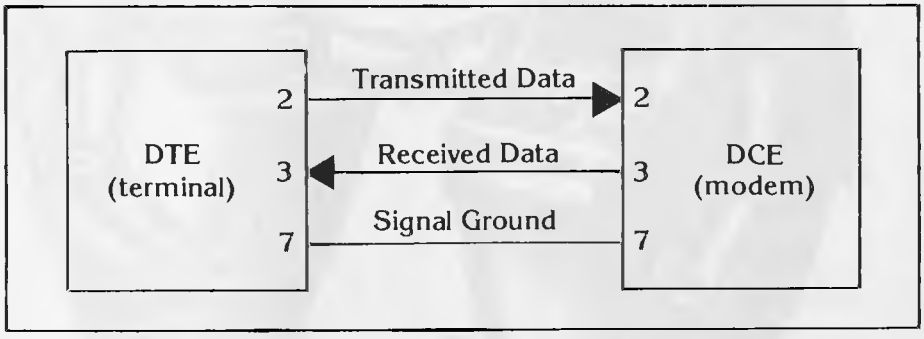


Figure 2

EXAMINING DATA WIRES

Information is sent out on the transmitted-data line while signals are received on the received-data line.

Note that this is not the same as the IEEE interfacing standard discussed previously. On that interface, one set of data lines carried information in both directions. Technology had not progressed sufficiently for RS-232C to have bidirectional signal lines.

Who transmits on the transmitted data line? All of the names for the RS-232C signals are from the perspective of the DTE. So the DTE transmits on the transmitted data line and the DCE receives it.

Similarly, the DTE receives data on the received line and the DCE transmits on it. Figure 2 should clear up any confusion about this.

Now let's get confused again. We have a computer and a printer. We are going to connect them using their "standard" RS-232C cables.

But which of them is the DTE and which is the DCE? More specifically, which is going to transmit on pin 2 of the connector and which on pin 3? Neither the computer nor the printer is a terminal or a modem.

Manufacturers of these instruments may offer cables to allow their equipment to look like either DTE or DCE. More often however, the RS-232C connector is installed on the rear panel of the instrument and no choice is possible. In the case of two instruments of the same type, a crosswire cable may have to be assembled to get signals on the correct wires. Usually this task falls to the user.

We have just covered one source of incompatability between pieces of RS-232C equipment: plug-to-plug. In order to discuss other potential problems we must understand the data signal.

First, the data signal levels are not like those of the interfaces we have discussed previously. Those interfaces were based on TTL integrated circuits. That logic family is based on 0- and 5-volt signals.

RS-232C was a standard long before TTL and so uses different voltage levels. A positive voltage between 5 and 25 volts is used to represent a logic 0 while a negative voltage between -5 and -25 volts is used to represent a logic 1.

These levels are only for the data lines which use negative true logic. The control lines all use positive true logic and so a positive voltage represents a logic 1 and a negative voltage represents a logic 0.

Because the bits of a character are separated by time, a waveform is produced when transmitting a character. Such a waveform for transmitting the character "E" is shown in figure 3. The ASCII code for "E" is 10000101 in binary and is transmitted least significant bit first. The data line idles in the "1" state.

WAITING FOR THE START BIT

A start bit is always sent first to mark the beginning of the character. Then data bits are sent in order from least significant to most significant, each bit remaining on the line for a precisely-arranged length of time called a bit time.

The receiver, alerted to the incoming character by the start bit, times the incoming signal and samples the state of the data line as close to the centre of the bit as it can. Naturally, both the transmitter and receiver must agree on the length of time each bit will be given on the line or the transmission will be garbled by samplings taken at the wrong times.

This bit time determines the maximum rate at which bits may be transmitted and thus defines the "bit rate" at which this particular serial interface is running. Standard bit rates are 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 3600, 4800, and 9600 bits per second.

Following the data bits in the transmission, there may be a parity bit, used for error detection. If a noise pulse should affect the data line at the wrong time, a bit in the transmission could be misread.

If the transmitter keeps track of the number of 1s in the character being transmitted, it could set the parity bit so that the total was either always even (even parity), or always odd (odd parity). The receiver can also keep track and use the parity bit to determine whether the transmission was received in error.

The last bits to be transmitted are the stop bits. These bits carry no information but allow the receiver time to prepare for the next character.

There may be 1, 1.5 or 2 bits. Since this period is really just a resting time, fractional bits are allowed.

PICKING UP THE PIECES

Now, what might go wrong? There are several parameters on which the transmitter and the receiver must agree. The bit rate has already been mentioned. In addition, the parity (odd, even or none) and the number of stop bits both have to be the same in the transmitter and the receiver.

Character codes also have to be considered. Our example used the ASCII code that is the most commonly used character code today. ASCII is a seven-bit code. Other codes do exist however, and may include 5 bits (Baudot and Murray), 6 bits (IBM Correspondence Code) and 8 bits (EBCDIC). The RS-232C standard makes no mention of what code should be used.

Now that we have our computer and printer connected so that they use the proper wires and they agree on bit rate, parity, number of stop bits and character codes, you may feel that the problem has been solved. — Not so. The printer uses the ASCII character set, has odd parity, and one stop bit. In addition, it has a switch for setting the bit rate up to 9600 baud.

Well, that's fine. We set the switch to its fastest setting so that our equipment doesn't waste a lot of time sending characters. We also set the computer to the same settings so that both the transmitter and the receiver agree on all of the parameters.

FINDING THE PROBLEM

We then write a program on the computer to send one line of print to the printer and it works! Finally, we list out the program on the printer so that we have a copy of our triumph. Unfortunately, several characters are lost in the transmission. We try again with equally dismal results. We run the program once more, and now that line prints perfectly. What is going wrong?

First, let's consider the data rate at which the computer is sending information. We are using ASCII (7 bits) plus a parity bit, a stop bit, and a start bit for a total of 10 bits. We are transmitting these 10-bit pieces of information at 9600 bits per second, which translates into 960 characters per second.

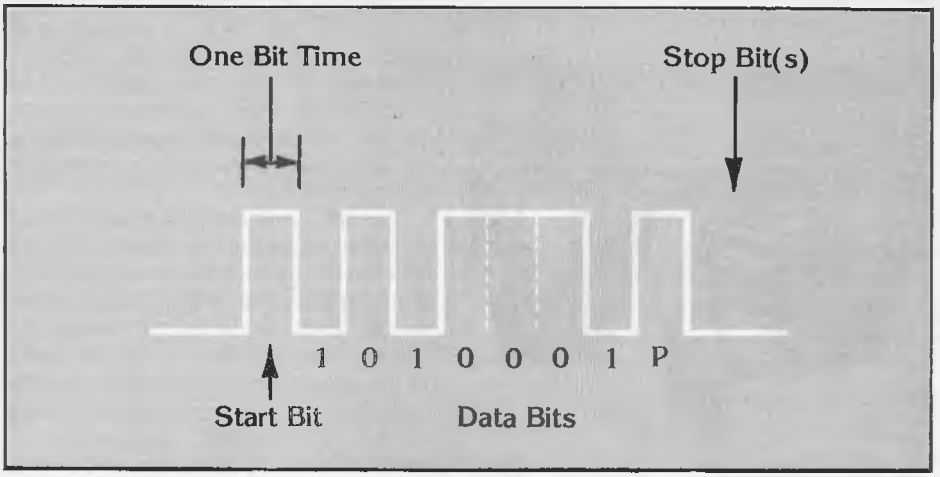


Figure 3

The printer manual specifies that the printer can print 175 characters per second. We are sending information to the printer at more than five times the rate it can print them! The printer does have an internal buffer for 127 characters. After that, the transmitter must wait to allow the buffer to partially empty.

When we ran the program, fewer than 127 characters were sent to the printer and the printer's buffer could handle the data rate. Listing the program sent more than 127 characters to the printer and the buffer overflowed, causing some characters to be lost.

In previous articles, we discussed interfaces that had handshake mechanisms which prevented transmitters of information from going too fast for their receivers. Surely RS-232C must have a handshake mechanism also — but no, this is not always true.

Returning to figure 1, we will now consider the other RS-232C signals. We are looking in particular for two sets of handshake lines, one for the transmitted data line and the other for the received data line.

Aha! Pins 4 and 5, request-to-send and clear-to-send, look like prime contenders. And many printer manufacturers have fallen into this trap. According to the strict RS-232C definition, the DTE asserts the request-to-send line when it has some data to transmit. It then waits for the DCE to assert the clear-to-send line before transmitting.

That is one half of a traditional handshake. The problem is that the DCE is not allowed to drop the clear-to-send line until DTE has dropped the request-to-send line.

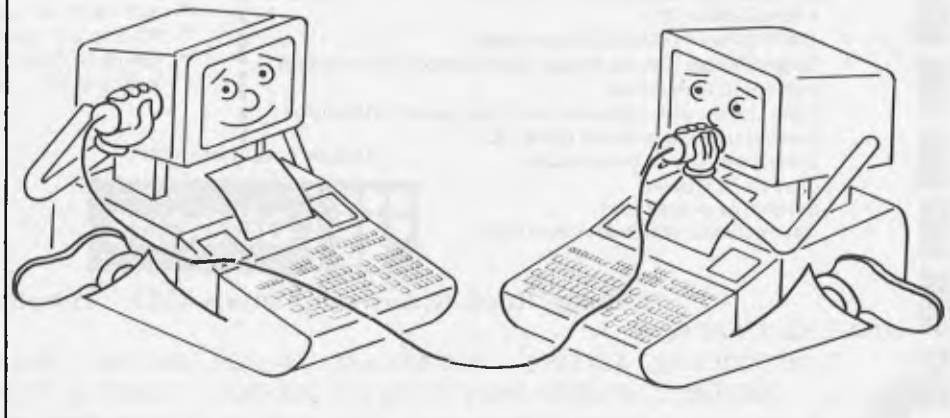
TAKE A LONG DRINK

The situation is similar to taking a drink from a garden hose with a friend controlling the nozzle. It's easy to start the flow, but you had better be prepared to take either a long drink or a short shower.

The DTE and DCE signals were intended as a handshake between the terminal and the modem to allow the terminal to request control of the communications link from the modem. It also makes it possible for the modem to tell the terminal when control has been acquired.

Some manufacturers have ignored this strict definition and used the clear-to-send line as a handshake line anyway. Others avoid the definition conflict by using the data-terminal-ready or data-set-ready line (depending on whether they are emulating a terminal or modem). None of these lines was intended for the purpose of handshaking characters, however, and use by one instrument does not guarantee recognition by the other.

Let us consider the possibilities of using the clear-to-send line. If the printer drops the clear-to-send signal



in the middle of a character, what should the computer do?

If it stops immediately in the middle of a character, the character is certain to be garbled. If it waits till the end of the current character to stop, it may overrun the receiver's buffer. Because this possibility is not covered in the standard, the results are not predictable without carefully reading manuals for both instruments.

Finally, consider the device that started this discussion, the teletypewriter. The RS-232C standard at least defines signal levels and a pinout on a connector. There are no standards for teletypewriters. The serial transmission concepts are the same with start and stop bits, data bits and parity bits, but the signal interface is called current loop.

Instead of positive and negative voltage levels to represent logic 0 and 1 levels, current loop uses the absence of presence of current. Presence may be either 20 or 60 milliamps depending on the teletypewriter model. There is no standard connector or pinout for teletypewriters.

Despite all these problems, designers of serial interfaces for computers strive to include current loop capabilities in their designs. Where RS-232C is limited to 50 feet for a direct connection, current loop can be run much farther. In addition, the teletypewriter interface has been around for many years, and several instruments, still useful to connect to computers, use it. Teletypewriters remain a cost-effective solution as a combination printer and terminal.

HANDLE WITH CARE

As you can see, serial interfacing needs to be approached more carefully than other forms of hardware interfacing techniques. There are several factors that are far from being standardized.

As technology progresses, serial interfaces become more adept at covering an ever-widening range of hardware. Unfortunately, this still doesn't guarantee an efficient interface in every application, because serial I/O remains the unstandard interface.

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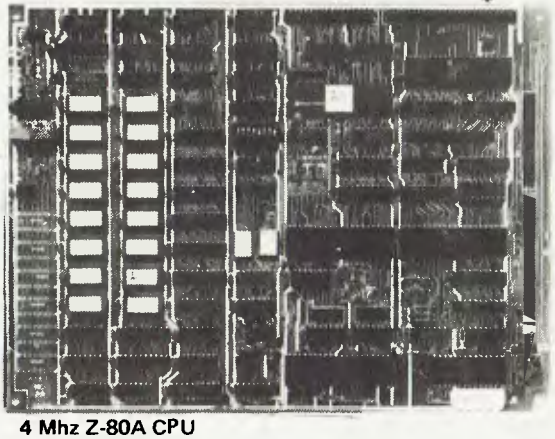

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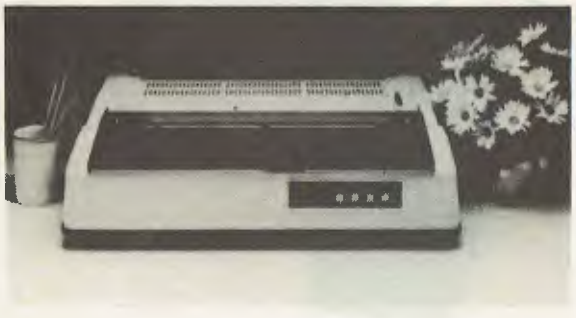

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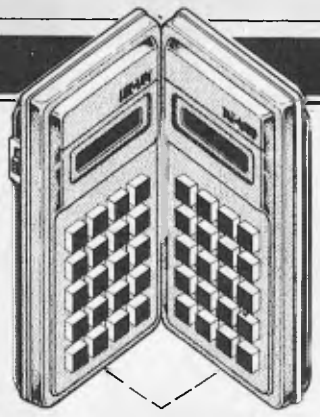


CALCULATOR CORNER

Compiled by Dick Pountain

Hewlett-Packard in a loop

On first hearing, the notion of networking HP-41C programmable calculators sounds a little daft — calculators are almost by definition personal and private instruments. Nevertheless, Hewlett-Packard has just announced a new interface, HP-IL, which does just that, and on closer examination it is far from daft.

It was, of course, Hewlett-Packard which invented the HP-IB interface for its large computers, and this, under its better known name of IEEE, has become an international standard for instrument control. HP is therefore no newcomer to the art of interface design.

HP-IL (the IL stands for Interface Loop) is as the name suggests a closed loop, using two wires to connect up to 961 devices in series. The reason that it isn't daft is that HP has announced at the same time several new peripherals to go onto the loop, as well as an interface card, for the HP-85 micro.

The first remarkable thing about HP-IL is its transmission capability, namely that data can be moved up to 5 kb per second (in one direction), and the distance between devices may be up to 100 metres; this, don't forget, is with *battery-powered* devices! For comparison, the widely used RS232 serial interface only allows five feet between stations.

The loop is operated on a 'master-slave' basis, where one device is nominated as master and sends a command around the ring which is received and passed on by each device in turn until it arrives back at the master; only the device for which the command is intended will act upon it. This system allows error checking, since the master can see whether the command is the same as when originally sent. A polling system allows user programs to be quite unspecific about devices, needing to specify neither address nor device number. For instance, a PRINT instruction will send a command that looks for any printer on the loop and activates the first one it finds.

So what can you hang on such a loop and why? The new peripherals announced include a digital cassette recorder, a new thermal printer, two new memory expansions, a real-time clock unit and a digital multimeter, plus interface adaptors for the HP-85 and for measuring instruments.

The cassette recorder provides 131k of storage per micro-cassette, using digital rather than audio encoding for speed and reliability. Searching is performed at 30in/sec. Programs as well as data can be stored in named files, and a directory is kept as on a floppy disk.

The thermal printer is basically the same unit as the current HP-41C printer but with the interface logic built in to allow its HP-IL use.

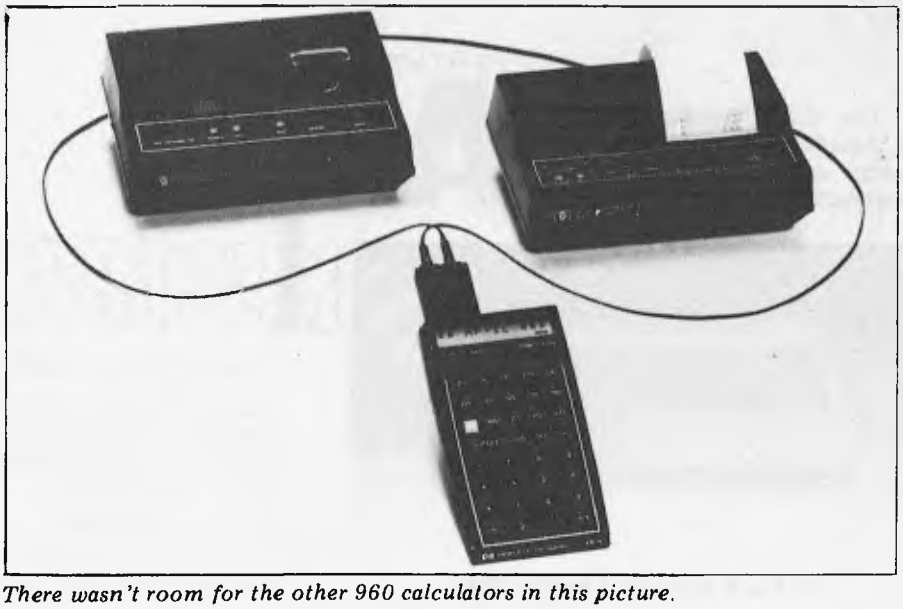
Two RAM extensions called HP82180 and 82181 allow the expansion of an HP41 C/CV to 6.5k of continuous memory. The first-named module contains, in addition to 889 bytes of RAM, a set of extended memory functions in ROM, which enable transfers to be made between main RAM and the 82181 module, two of which (1666 bytes apiece) may be added. Thus the extended memory is not contiguous with the main RAM but is addressed as an external device using the new commands to set up files. File types supported are Program, Data and ASCII; this last being particularly useful for communicating with another computer such as the HP-80 series.

So what can you use HP-IL for? One obvious application is merely to allow attachment of the printer, cassette recorder and expansion memory to a single HP-41C. Another, more novel, is to include an instrument like the multimeter in the loop and control it from a 41C, processing its data output and storing it on tape or printing it. Using the real-time clock module this could be made to be an automatic process, sampling at regular intervals without human intervention. Since all these peripherals are battery-operated, this could all happen just as well in the middle of a forest or desert as in the laboratory. In addition to HP's own multimeter a board has been produced to build into other instruments making them HP-IL compatible.

If you want to go the whole hog you can stick an HP-85 microcomputer into the loop so that data can be passed between one or more hand-held HP41Cs and the computer: the 41C thus becomes an intelligent data capture terminal. Obviously programs cannot be downloaded since the 41C doesn't speak Basic and vice versa; data must be sent in ASCII form.

HP intends HP-IL to become a permanent and extensive 'small systems' interface, and is planning to make all its future small products compatible with it. Rumoured for the near future is a video interface to allow the 41C to display on a CRT, and an HP-IL/RS232 connector.

With the introduction of this product the 41C/CV now more than lives up to the title of 'hand-held computer' and the system should prove a cost-effective solution to a variety of laboratory data-logging problems, especially where mains power is unreliable or unavailable. I look forward to testing some of this hardware in the near future and perhaps comparing it with the Panasonic HHC which is the only other hand-held system which approaches the HP's new found abilities. END



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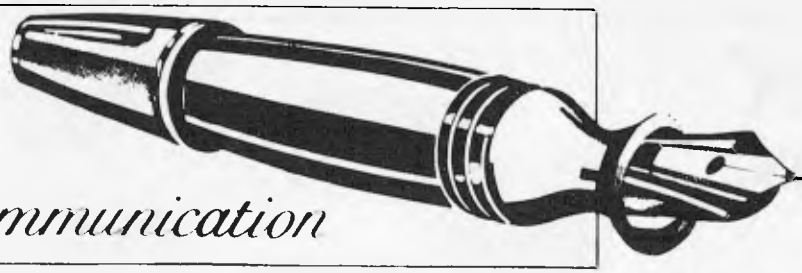


Communication

APC welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add 'not for publication' if your letter is to be kept private. Address letters to: 'Communications', Australian Personal Computer, 462 Burwood Road, Hawthorn, Vic. 3122.

Success at last

The submission of PET 'Fantasy' by Jeff Aughton from your February edition who states that no one has yet succeeded in gaining enough treasure in which to escape has now been proved wrong.

It all began when we arrived at school to find that it was to close down for the day at 12.30pm, but a handful of us from our year twelve computer club, plus teacher, attempted to get out of the adventure game using a 32k 40 column PET for which the program was designed, and after three hours we eventually got out.

This wasn't done by pure chance but by the use of a map which was constructed very laboriously by trying each exit given to us, and so we found that we had consequently drawn a foolproof map which would work each time the program was run.

The program was a great challenge to us all and we praise all the various other programs which have been submitted by Jeff Aughton in the past.

J. Chapman

HP-85ers wanted

I'd like to contact other HP-85 users to exchange programs and methods, especially ones using the HP-IB and serial interface. Please contact: Rosy Thompson, 71 Beachcomber Avenue, Bundeern, N.S.W. 2230

One liner

The conversion of decimal numbers to binary often causes problems, particularly when negative numbers are converted using '2's complement'.

Here is a compact conversion program in Microsoft 2 Basic which can be added to a collection of 'one-liners'.

```
0 INPUTD:D=D/16∧4:
FOR I=0 TO 15:D=2*
(D-INT(D)):PRINT-
(D>=1); :NEXT:RUN
```

Jack Pike.

Relocatable codes

I note with much interest Mr Jeff Richards' method of arranging relocatable machine code, even where easy instructions are not available in the CPU instruction sets (APC, Feb 1982). This is a question that has been raised a number of times in recent months in several overseas micro magazines.

The issue is solvable only if we have an instruction that gives a "Where are we?" answer. Mr Richards correctly decides that we need, in the absence of an intrinsic CPU function of this sort (e.g. LD HL,PC in Z80 style notation), one calls on a fixed address subroutine to help out. Mr Richards uses his SETUP subroutine.

Now, the TRS-80 Model 1, at least, has such a routine already in ROM. At location 000B, are the two lines of code:

```
POP   HL
JP    (HL)
```

I believe neither ROM Basic, nor Disk Basic, nor DOS uses this little routine. A call to 000B puts the caller's absolute address into HL, then returns to the caller. Voila! Exactly as good as LD HL,PC.

Mr Richards indicates that while a "relative call" is achievable over short jumps, using JR (jump relative) calls, longer calls are a problem. However, longer calls can be made using JP (HL) to anywhere in memory.

I include listings for the following (for the Z80/TRS-80):

1. A relocatable long jump.
2. A relocatable short call (or "relative call").
3. A relocatable long call.
4. The suitable subroutine for calls 2 and 3 above.
5. A relocatable reference to a buffer or pointer.

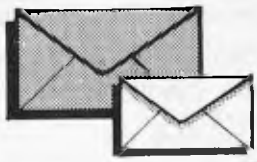
B. Lavery.

```
;*****************************************************
;**              RELOCATABLE LONG JUMP              **
;*****************************************************
        CALL    000BH           *
LOCN1   LD      DE,LOCN4-LOCN1  *
        ADD     HL,DE           *  EQUALS "JP LOCN4"
        JP      (HL)            *
LOCN2   (Code we jump over)

LOCN4   (Code we want to jump to)
;*****************************************************
;**              RELOCATABLE SHORT CALL             **
;**               (OR "RELATIVE CALL")              **
;*****************************************************
        CALL    000BH           **
LOCN1   JR      SUBR1           **  EQUALS "CALL SUBR1"
LOCN2   (Continue here after "call")

SUBR1   (SUBROUTINE, SEE BELOW)
;*****************************************************
;**              RELOCATABLE LONG CALL              **
;*****************************************************
        CALL    000BH           *
LOCN1   LD      DE,LOCN2-LOCN1--2  *
        ADD     HL,DE           *
        PUSH    HL              *
        POP     IY              *
        LD      DE,SUBR1-LOCN2+2   *
        ADD     IY,DE           *  EQUALS "CALL SUBR1"
        JP      (IY)            *
LOCN2   (Return here after "call")
        ...
SUBR1     (USE SUBROUTINE AS BELOW)
;*****************************************************
;**       COMMON SUBROUTINE FOR RELOC CALLS         **
;*****************************************************

SUBR1   INC     HL
        INC     HL
        PUSH    HL
        ( S U B R O U T I N E
        C O D E )
        ..........
        RET
;*****************************************************
;**              RELOCATABLE BUFFER POINTER         **
;*****************************************************
        CALL    000BH           *
LOCN1   LD      DE,BUFLOC-LOCN1    * EQUALS "LD HL,BUFLOC"
        ADD     HL,DE           *
        LD      (HL),VALUE        (OR PRINT STRING, ETC)
        ...
        ...
BUFLOC  DEFB    00              ;(OR DEFM ETC)
        ...
;*****************************************************
```



Missing matrices

How do I replace commands such as MAT A=B, MAT PRINT, etc. These are available on the Mainframe that I use at college, but not on my brother's micro.
L Lee.

Not many micros support these commands because of the amount of extra space the compiler/interpreter would use. Just in case some people have never heard of these commands I will briefly outline what they do.

The MAT commands handle and manipulate arrays using a single statement. The statements only know how to manipulate the arrays because they have already been dimensioned using a DIM statement. Suppose we have statement DIM A (10,3), B (10,3), C (10,3) then a statement such as MAT PRINT A will print the whole arrayA. MAT C=A will copy the whole array A into array C. There are many statements that can be used — for example, MAT C=A+D — and operators such as +, = and * can be used with many other functions possible.

There is insufficient space here to describe the full meaning of the words such as the 'transpose' of a matrix so I will just give their equivalent Basic constructs. The arrays must have been previously dimensioned as DIM A (M,N), B (M,N), C (M,N).

Editor.

```
MAT A=B
-------
10 FOR I=1 TO M
20   FOR J=1 TO N
30     LET A(I,J)=B(I,J)
40   NEXT J
50 NEXT I
Use the above program and make the changes below
MAT PRINT A - replace 30 PRINT A(I,J);
              insert 45 PRINT
MAT B=CON     30 B(I,J)=1
MAT B=ZER     30 B(I,J)=0
MAT B=IDN     omit line 20,40
              30 B(I,I)=1   matrix must be square ie M=N
MAT INPUT A   30 INPUT A(I,J)
MAT C=A+B     30 C(I,J)=A(I,J)+B(I,J)
MAT C=(K)*A   30 C(I,J)=K*A(I,J)
MAT C=A-B     30 C(I,J)=A(I,J)-B(I,J)
MAT C=TRN(A)  30 C(I,J)=A(J,I) matrix must be square
MAT C=INV too complex to do here, refer to a book on matrices.

MAT C=A*B
---------
Matrices must be compatible, ie, dimensions of M x N and N x P
  5 MAT C=ZER
 10 FOR I=1 TO M
 20   FOR K=1 TO P
 30     FOR J=1 TO N
 40       C(I,K)=C(I,K)+A(I,J)*B(J,K)
 50     NEXT J
 60   NEXT K
 70 NEXT I
```

VIC Comal?

Would it be possible on the VIC-20 to use other languages like Comal-80? I am a very frustrated Basic user — a change would do me good!
G Doyle

Basic is most popular on 8-bit microcomputers for a number of reasons, not all of which are still valid. Comal-80 has been implemented on the Commodore PET and there appears to be no reason why, given sufficient memory, a version could not be implemented on the VIC-20. As yet such a version does not exist, but it should not prove too difficult to do.

Editor

Osborne maths?

Is the Osborne 1 reasonably accurate for use by a mathematician? Does it have high resolution graphics? Is colour available as standard or as an option? Does it have programmable function keys? If the answers to the first two are 'no', can you suggest an alternative, at no greater expense?
S Mahmood.

I am not sure how much 'accuracy' you have in mind. In my general computing experience (as opposed to microcomputing) it is the accountants who tend to demand the highest level of precision, although certain physical sciences (especially astronomy) can demand accurate values for small differences between large numbers, which demands a high level of precision.

In any case, the number of significant figures accurately attainable is a function, firstly, of the 'word-size' of the CPU, and secondly, of the software. As you know, all 8-bit micros are limited to five significant figures (or even to four) when handling numbers without any special software or hardware. However, as the Osborne 1 runs under CP/M you should have little difficulty in getting software for whatever precision you need, or of adopting routines in high level languages if you want to do something like calculating pi to many places. If you use a Basic, which uses BCD coding for 'real' numbers, rather than the commoner pure binary notation, you will also eliminate errors due to the conversion from decimal to binary and back. MBasic (which runs under CP/M) supports the 'double precision' option, this allows around 12 significant figures.

I regret to say that the answer to all three of your other questions is 'no'. As regards alternatives to the Osborne 1, at no greater cost, which offer high resolution graphics, and colour, the first point is that none of the possibilities will offer the same degree of portability. Having said this, you may like to consider choosing from a wide range which includes the Apple II with extra cards. Atari 800, Hewlett-Packard HP 45/85, suitably expanded.

Editor

Laser printers

As part of a recent school project I am collecting information on the different types of printers. I cannot find information on two types, and would be grateful for your help. The types in question are electrostatic and laser printers.
S Grimes.

There are two types of printers which can be referred to as 'electrostatic'. The more common type prints on special aluminium coated paper using a dot matrix technique. For each dot to be printed an electrically generated spark evaporates the very thin coating of aluminium, leaving the dark coloured paper to show through. The resultant print out is not very elegant, but does yield good photocopies! These printers are relatively cheap, and are often used as screen printers. The new Sinclair ZX printer uses this technique.

The term 'electrostatic printer' is also applied to certain specialised printers based on the xerographic process, incorporated in 'communicating photocopiers'.

Laser printers are currently being developed, particularly by IBM, to provide a fast 'letter quality' printer for word processing in particular. These printers use semiconductor lasers to burn patters into paper, the patterns being letters, numbers or other special symbols, including 'graphics' if required. The technique is claimed to work with ordinary paper, and needs no ink or ribbons.

Have you included the 'ink-jet' printer in your collection? These very versatile, and increasingly popular printers operate by squirting small drops of ink onto the paper, in controlled patterns. The ink drops are often steered onto the paper electrostatically.

Editor

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APC-80 Version 6

APC-80, the popular series for TRS-80s and System 80s continues this month, presenting a new routine to save time, finger-nails and frustration.

I imagine that almost everyone is familiar with the annoying experience of typing a long line of Basic statements for immediate execution (i.e. without a line number) and, upon pressing the enter key, discovering a typing error somewhere in the line. The only course of action is to type the entire line all over again, usually creating a new error in the process.

Not any more! APC-80 version six provides you with the facility of editing and re-entering the last command line, thereby allowing typing errors to be corrected easily and quickly. It also allows you to re-execute the last command line even if there were nothing wrong with it.

The facility is invoked by pressing shift, down arrow and "E", all at the same time. It results in the old contents of the I/O buffer being called up and passed to the standard level II EDIT routine, implying that all the normal features of the EDIT command are available (all except "A", as explained later). The line may then be changed in whatever way you like, or left the same for re-execution, and when EDIT is exited via the ENTER or "E" command, the line will be passed to the interpreter for execution. The facility cannot be used within Basic programs for the simple reason that the level II EDIT routine is not that flexible. Remember that since APC-80 assumes the I/O buffer to be untouched since the last line was entered, if you type the same characters and then backspace and try to call up the last line entered, the result you will be editing is a combination of the previous line and the characters which you had typed on the current line. The level II ROM routines place new characters into the I/O buffer as they are typed, and backspacing does not remove them from the buffer.

To test the new routine, try this simple experiment. Type the line

```
A=A+1 : PRINT "A=" ; A
```

and press enter. Naturally enough it should tell you that A is equal to one. Then invoke the new APC-80 function by pressing shift, down arrow and "E". The cursor should advance one space to indicate the editor is active. Then press either "E" or enter to exit the edit routine (the two edit commands are the same, except "enter" which will also list the line as it exits), and you should find that it prints "A=2". You can repeat this process until the novelty wears off, and each time the value of A should change by one. Once you have convinced yourself that this works, enter the APC-80 editor again (shift, down arrow, "E") and try changing the line slightly, for example, change the "1" to "2". You should now find that the value of A is changing by two each time. If this works, you can be sure that APC-80 has been set up correctly and relax in the knowledge that the routine is there to be called up next time you make a typing error.

APC-80 UPDATES

The procedure for including this new APC-80 facility is very easy. Simply load up your existing version of APC-80 in Basic, and type in the lines shown in listing one, being extremely careful not to make any errors, such as mis-reading a character "B" as a number "8". When this is complete, save the Basic program back to tape and APC-80 is ready to run. Note that the memory size to use when running version six is 31700.

HOW IT WORKS

Looking now at listing two, we see the assembler version of the new APC-80 routine. The routine is linked into the calling chain of routines which are activated every time the keyboard is scanned. This routine ("REDO") is called by another routine everytime that routine wants to check out the keyboard. In fact, the calling routine is itself called from a routine one level further back, and so on, through many levels. The REDO routine calls another APC-80 routine called DEBOUN, to scan the keyboard and tests the result to see if the special code is activated (shift, down arrow, "E" has the ASCII code of 05). If the special code were not entered, REDO returns to its caller in the normal way.

Once it has been determined that the required combination of keys are down, REDO then checks to make sure it has not been called from an executing Basic program. If everything is OK (that is, we are in command mode), REDO grabs the I/O buffer pointer and decrements it twice to ensure the first two bytes are also included. This is necessary because the first two bytes of the I/O buffer are used to store the line number, if one were entered. The adjusted I/O pointer is then pushed onto the stack for later usage. REDO then continues by executing a "CPIR" instruction to search for the end of the line, as indicated by a zero byte. The start of the I/O buffer is then recovered off the stack and replaced with a pointer to the end of the line. The physical end of the I/O buffer is then determined by adding 255 to the start address. We then do a few manipulations to set up other pointers and length counters, and then execute a "LDDR" instruction to move the line stored in the I/O buffer up to the end of the I/O buffer. This allows the ROM "de-tokenisation" routine (at address 2B7E) to be called. This routine cannot perform "in-place" expansion of Basic keywords, hence the line to be expanded was moved to the top end of the I/O buffer, and expansion takes place into the bottom end.

The next thing to do is to set up the return address to be used when EDIT finishes. This return address is 1A81, a strategic point in the Basic interpreter which will cause the I/O buffer to be executed. This address is placed on the stack, followed closely by the line number to be used by EDIT. The line number specified is FFFF, or 65,535, which holds special significance for the level II EDIT routine and allows us to control what happens when the EDIT finishes. Lastly, we set up the HL register pair to point to the start of the I/O buffer and jump into a convenient place in the EDIT routine.

Because we specified a line number of 65,535, if you give the "L" edit command, EDIT will indicate that you are editing line number 65,535. In fact this is not the case, 65,535 is a special line number which cannot normally be generated, and which prevents EDIT from attempting to replace the line into program storage.

As stated before, the "A" edit command will not work when you are editing the last line. This is because "A" operates by re-retrieving the line being edited from program storage area, thereby removing any changes made to the copy in the I/O buffer. Since what we are editing did not come from the program storage area, we have nowhere from where to get a fresh

copy, and hence the "A" command will fail with an "undefined line number" error, when line 65,535 is not located.

APC-80 BLUDNERS

In the last APC-80 article, "APC-80 Rides Again", a couple of errors sneaked past our proof-reader. The first of these is on page 66, second column in the third paragraph. The example should read :

"IF A > B THEN BEEP 30,30
ELSE BEEP 100,100
should be coded as
IF A > B THEN : BEEP 30,30
ELSE : BEEP 100,100"

The second error is in table 3, where the assembler directive "ORG" was printed as "OR6". I have been given a personal assurance that nomore s uch erorrs will occcu raga in.

LISTING ONE

Basic modifications to upgrade to version six. Note that byte three in line 1710 is "EB" not "E8".

```
400 DATA 4E, 20, 36, 1A, 00
910 DATA D4, 7B, FE, 61, D8, DD, 21, 62
1650 ' EDIT LAST ENTRY
1660 DATA ORG, 31700
1670 DATA CD, 14, 7C, FE, 05, 28, 02, A7
1680 DATA C9, 2A, A2, 40, 23, 7C, B5, 3E
1690 DATA 00, C0, 2A, A7, 40, 2B, 2B, E5
1700 DATA AF, 4F, ED, B1, D1, E5, 21, FF
1710 DATA 00, 19, EB, E1, 2B, 79, ED, 44
1720 DATA 4F, 06, 00, ED, B8, EB, 23, CD
1730 DATA 7E, 2B, 21, 81, 1A, E5, 21, FF
1740 DATA FF, E5, 2A, A7, 40, C3, 81, 2E
1750 DATA END
```

LISTING TWO

The assembly listing of the new APC-80 routine. Note that the instruction at address 7E36 should be changed to "JP REDO" in order to activate the routine.

```
                07750
                07760 ; EDIT LAST ENTRY FACILITY
                07770
                07780
7BD4            07790          ORG     31700
7BD4 CD147C     07800 REDO     CALL    DEBOUN      ; GET CHAR
7BD7 FE05       07810          CP      05H         ; CHECK FOR SPECIAL CODE
7BD9 2802       07820          JR      Z,EDITIT    ; IF MATCHED
7BDB A7         07830          AND     A           ; RESET FLAGS
7BDC C9         07840          RET                 ; AND GO HOME
7BDD 2AA240     07850 EDITIT   LD      HL,(40A2H)  ; CHECK FOR PGM EXECUTION
7BE0 23         07860          INC     HL          ; MUST BE 0000
7BE1 7C         07870          LD      A,H         ; TAKE MSB
7BE2 B5         07880          OR      L           ; COMBINE WITH LSB
7BE3 3E00       07890          LD      A,0         ; SET A TO ZERO IN CASE
7BE5 C0         07900          RET     NZ          ; IGNORE IF IN INPUT
7BE6 2AA740     07910          LD      HL,(40A7H)  ; I/O POINTER
7BE9 2B         07920          DEC     HL
7BEA 2B         07930          DEC     HL          ; BACK TWO BYTES
7BEB E5         07940          PUSH    HL          ; SAVE START POINT
7BEC AF         07950          XOR     A           ; SET A TO ZERO
7BED 4F         07960          LD      C,A         ; SET LSB OF COUNTER TO 0
7BEE EDB1       07970          CPIR                ; FIND END OF LINE
7BF0 D1         07980          POP     DE          ; RECOVER START POINT
7BF1 E5         07990          PUSH    HL          ; SAVE END POINT
7BF2 21FF00     08000          LD      HL,255      ; LENGTH OF I/O BUFFER
7BF5 19         08010          ADD     HL,DE       ; HL = END OF BUFFER
7BF6 EB         08020          EX      DE,HL       ; NOW DE
7BF7 E1         08030          POP     HL          ; RECOVER END POINT
7BF8 2B         08040          DEC     HL
7BF9 79         08050          LD      A,C         ; MOVE LSB OF LENGTH
7BFA ED44       08060          NEG                 ; AND MAKE IT POSITIVE
7BFC 4F         08070          LD      C,A         ; PUT BACK IN C
7BFD 0600       08080          LD      B,0         ; ZERO MSB OF COUNTER
7BFF EDB8       08090          LDDR                ; MOVE TO END OF BUFFER
7C01 EB         08100          EX      DE,HL       ; HL POINTS TO START OF
7C02 23         08110          INC     HL          ; SHIFTED STRING
7C03 CD7E2B     08120          CALL    2B7EH       ; EXPAND INTO I/O BUFFER
7C06 21811A     08130          LD      HL,1A81H    ; SET RETURN ADDRESS
7C09 E5         08140          PUSH    HL          ; AND PLACE ON STACK
7C0A 21FFFF     08150          LD      HL,0FFFFH
7C0D E5         08160          PUSH    HL          ; AND IMMED FLAG
7C0E 2AA740     08170          LD      HL,(40A7H)  ; POINTER TO I/O BUFFER
7C11 C3812E     08180          JP      2E81H       ; JUMP INTO EDIT
                08190
0000            08200          END
00000 TOTAL ERRORS
```


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CHECKOUT

Micro BEE

by Ian Davies

The Micro-Bee is the latest kit computer from Applied Technology and is probably the most powerful of all the low cost machines currently flooding the market. Selling for $399, it comes with 16k of RAM, 16k of ROM, RS-232 interface, sound generator, lower case characters and high resolution graphics.

The unit is about twice the size of a ZX81, and includes a real 60 key QWERTY keyboard — small but definitely manageable. The machine is Australian designed by Applied Technology, a name that for many years has been prominent in the field of kits, board level computery and components. It features a 2 MHz Z80 microprocessor and, for a change, a non-Microsoft ROM. The ROM claims it was 'written by Mathew Starr (1982) for MICROWORLD', and therefore shows some interesting deviations from the old Microsoft standards. I will not go into the kit aspects of the machine just yet, but start by looking at the machine as a machine, and seeing what it has to offer.

Hardware/Software

The Micro-Bee uses an external twelve volt supply (provided) to cut down on size and safety regulations. The voltage regulators are on-board, and nothing seems to run too hot. The keyboard is angled very slightly backwards, and if you have much to do with keyboards, feels very odd the first time you lay hands on it. Much to my surprise, the feeling wore off very quickly and was never noticeable again. It seems it was just an initial shock in handling a keyboard that's not sloped five degrees forward (ZX80 owners won't notice a thing). The machine outputs a direct video black and white signal which can be fed into a monitor or a modified TV set. Alternatively, you can purchase a modulator and connect it straight into a normal TV. It would have been nice if the unit came standard with an RF modulator. I ran it into a modified TV set, and the result was very pleasing. I would recommend the same method for most people, as a small Black and White TV is cheaper than a monitor and can still be used for normal viewing. The modification to allow direct video input is not difficult to do and generally produced a higher quality result than does a modulator.

The RS-232 interface can be read and written very easily in Basic programs at either 300 or 1200 baud. The cassette interface can also run at 300 or 1200 baud, although I would use the 300 baud option on most portable cassette players. The sound generator can produce 24 different tones with a duration variable in eighth second increments. It is not capable of fancy sound effects or violin concerto, but it is sufficient for playing tunes or producing simple noises in Basic programs.

The upper and lower case characters are very readable, but loose definition in 'inverse' mode. Lower case variables are considered to be the same as upper case variables of the same name, which is good, as I have used a machine where the variable 'A' is different from the variable 'a', and it can become an easy source of bugs. On this machine, if you give the statement 'a=7' and then 'PRINT A', the value 7 will appear. Unfortunately, variable names are fairly restricted. Numeric variables may be named by one alphabetic character, optionally followed by one numeric digit. This method is getting back to the old Dartmouth standard, which is probably best forgotten. String variable names are even worse. These must be an alphabetic followed by a numeric followed by a dollar sign. In other words, 'A' is an illegal variable name, it must instead be 'AØ$' or 'A1$', etc.

The keyboard features auto-repeat when a key is held down. Basic programs can be terminated by pressing the BREAK key or by control C. Program output can be paused and re-started by use of control S and control Q, respectively. Now it gets interesting. The keyboard also contains a key labelled "REPT" which, if you have much to do with terminals, usually stands for REPEAT and appears on terminals which do not have the auto-repeat facility. Applied Technology says it stands for "REPROMPT", a name created to correspond to the key label. In fact, it is a 'warm start' key which, when held down for about half a second, generates an interrupt and returns the machine to a "ready" state without destroying the program or variables. This seems like a very good idea, as most key pressing takes a lot less than half a second and therefore accidentally pushing the warm start button would usually have no effect. My only criticism is the name of the key, "REPT" is far too misleading — something like "RESET" would be better.

Holding the "ESC" and "REPT" keys down together will generate a cold start, which is equivalent to a power-up in that the program is removed and all variables are lost. The "ESC" key also

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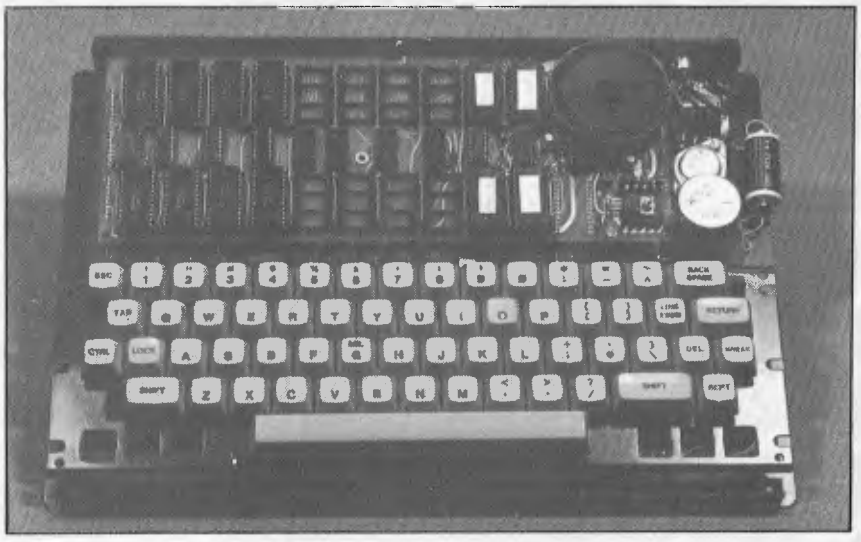
allows you to reposition the active area of the screen. Pressing "ESC" followed by "S" will transpose the screen one character position to the right. Similarly, "A", "W" and "Z" allow movement left, up and down, respectively. This is an interesting feature and, although the manual did not say so, is presumably used for correcting alignment differences between the computer and the TV.

Two graphics modes are provided. The first is low resolution graphics giving 128 by 48 pixels - the same as the TRS-80/System 80. The high resolution mode supplies 512 by 256 pixels. Both modes can be intermixed with character information on the normal 64 by 16 position grid. An additional graphics feature is "programmable characters", and it is here that the machine starts to fall down. The manual gives an example of user defined characters (little men and spaceships), but nowhere does it tell you how to define your own characters. It says that this topic is covered elsewhere - but the 'elsewhere' never turns up!

The character set consists of 128 permanent characters and 128 programmables. The high resolution graphics are generated (transparently to the user) by defining programmable characters and displaying them. A clever trick, but the fact that there is only room for 128 programmable characters means that sooner or later you are going to run out, and it is often sooner. I wrote a program which used the PLOT statement to draw a single border around the screen and then used PLOT 1 to draw a line between a series of randomly chosen points. After five to ten random lines, the programmable characters were exhausted and the program terminated with an error. Although you can generate a reasonable amount of graphics before running out of space, the fact that the limitation was so easy to detect means that it must be considered as a serious short coming in the system. I was quite disappointed about finding the problem, as the machine was measuring up extremely well until this point.



MicroBee with cover removed.

Apart from the matter just mentioned, the graphics functions seem quite flexible. There are the usual SET, RESET and POINT functions which can be used in either high or low resolution mode, with different allowable ranges, for example, SET (200, 200) is legal in high resolution mode, but not in low resolution. A PLOT statement is also provided for drawing lines between a series of points. It has four forms: the first of which simply draws a normal line, PLOTR resets the pixels along the line, PLOT 1 toggles the pixels and PLOTH is the same as PLOT except it inverts the vertical axis. It is not possible to combine options, e.g. PLOTRH, but this is not a serious restriction as it is unlikely that anyone would want to use the "H" option.

The screen is generated using a 6545 CRT controller chip, which explains why high resolution graphics rely on programmable characters. The 6545 allows a wide variety of video outputs, some of which are made available by the Micro Bee. Automatic underlining is provided, as are reverse video characters Only one of these can be active at the same time,which is not due to the 6545, but to the way in which it is used. For the same reason, no automatic flashing or dual intensity is available. The 6545 does have an input for a light pen, but Applied Technology decided to adapt this logic to keyboard scanning thereby dropping the cost of the machine, but also preventing the 6545 from being interfaced to a light pen. Presumably a light pen could still be attached through some other interface, but it would not be as convenient as using the 6545 facility. The manual states that the 6545 can be programmed to allow other display formats (e.g. 80 x 24), but I suspect that a ROM change would also be required. The only other point of interest on the video side of things is the cursor. It is normally a flashing underline character and, since it is generated directly by the 6545, can very easily be turned off, made into a block of reverse video or be made to stop flashing. The backspace key is logically destructive and although this is common on many of the larger mainframes, is nevertheless confusing.

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One of the most refreshing features the machine has to offer is parameters on subroutine calls. This means that subroutines can be called by GOSUB [A, 7.1, C9] 1000 the first line of the subroutine at 1000 would then be 1000 VAR (Z1, Z2, Z3) This has the effect of moving the values specified in the GOSUB into the variables listed in the VAR statement. The parameter variables are not local to the subroutine and hence results may be passed back through them. With features like this, it is a real pity that the variable names are so restricted.

User definable functions are also provided, however these are also a bit restricted. Only seven user definable functions may be used and they are identified by a single digit. They can also only have one parameter. For example: FN2 = SIN (#) / COS (#) The "#" symbol is used to represent the parameter passed into the function. Although these restrictions do serve to limit the usefulness of the functions, it should be remembered that many machines do not provide them at all on their base models, and that parameters on subroutines more than make up for possible short comings in other areas.

Only two data types are available, these being string or single precision. There are no true integer or double precision modes, although the SD statement can be used to set the number of significant digits to use in calculations. One advantage of supporting single precision only is that it is possible to PEEK or POKE locations above 32,767 without using negative addresses required by most MICROSOFT Basics. To my mind this is a much more sensible way of POKEing.

The manual did not have much to say about strings, but I assumed that the usual limit of 255 characters would apply and ran a small program to test it, shown below:

```
10 STRS (1000)
20 A1$ = " "
30 A1$ = A1$ + "X"
40 N = N + 1
50 GOTO 30
```

The STRS statement is used to reserve string space, and I gave it lots of room just to be on the safe side. The program ran for a while, and then aborted, just as expected. The length of A1$ was 254 - a bit surprising, but nothing to be amazed about. Further probing revealed that it had used up its 1000 bytes of string space and that N was equal to 766. Now that is incredible! I could find no rational explanation for these strange results — perhaps Applied Technology could shed some light on the matter.

The MICROWORLD Basic provides a string function called SEARCH, which is effectively the equivalent of INSTR in most other Basics, used for searching a string for sub-strings. A couple of string functions are noticeable by their absence, namely LEFT$, RIGHT$ and MID$; although it could be possible to implement these using PEEKs.

The Basic also supports some nice program maintenance features, such as a high quality RENUMber. An interesting command is the global search and replace, called GX, which allows you to search through the entire program changing all occurrences of a specified string to another string. For example, GX/FRED/HARRY/ would change all occurrences of FRED to HARRY. Each time it locates an occurrence of the first string, it lists the line containing it and marks the start of the string by a block of reverse video. The user may then push the full stop key to change the string, or any other key to advance to the next occurrence. It is a very nice idea, but I feel it would have been more powerful if it allowed you to leave out the second string and thereby do searching, and if it were possible to specify a range of line numbers. Unfortunately the GX function does not allow you to use strings which contain slashes ("/"), as this character is reserved to delimit the strings.

There is no PRINT USING statement, but it is possible to perform some basic formatting in a FORTRAN type style, for example, PRINT [I5 X], [F9.2 Y] would print the value of X as an integer in five spaces, and Y in nine spaces with two decimals. There is also an exponential format (scientific notation), and a rather peculiar alpha format which might, conceivably, come in handy sometime.

One of the most sensible things I have seen for a long time is the MICRO BEE method of handling different 1/0 devices. Two statements are provided, IN and OUT, which are used for selecting the source of data for INPUT statements and the destination of output for PRINT statements, respectively. The statement keywork is followed by a numeric expression in the range zero to five, and optionally followed by "ON" or "OFF". In this way, 1/0 may be directed to different combinations of devices, with devices being selectively added or removed. The MICRO BEE still supports the old PRINT/LPRINT pair, and a second parameter on the OUT statement means that these two streams of output can be treated separately and redirected to different devices. It is possible to direct printer output to the screen, but unfortunately it is not possible to do the reverse. This appeared to be the only lack of flexibility in their 1/0 system. Devices accessible include keyboard, VDU, printer, cassette at 300 baud, cassette at 1200 baud, RS-232 at 300 baud and RS-232 at 1200 baud.

The full repetoire of statements and functions are listed elsewhere in this article, but it is probably worthwhile going quickly over some of the more unusual of them.

Assembly

The SPEED statement selects the display speed of the VDU. ZONE is a statement used to control the spacing of print zones on output, as used when elements in a PRINT statement are separated by commas rather than semicolons. PRMT allows the prompt character to be changed from the normal question mark to any character of the programmers choosing. The RESTORE statement has an extra option on it which allows restoration to a particular line of DATA statements. This is particularly handy, as it is quite common for a program to require one set of DATA for once only initialization, and another set which is repeatedly used during execution. The benchmark timings reveal nothing unexpected, except that the results of BM-8 are missing. The machine does have an exponential function ("↑"), but it would not work in "LET" statements. It worked in PRINT statements, but as soon as I tried to store the result in a variable, the machine produced a diagnostic. The manual does not have a section on arithmetic expressions, so it is possible that there are some special rules. It is more likely, however, that it is the result of some bug in the interpreter. While this sounds like a fairly serious situation, it is a problem that is easily solved by Applied Technology or MICROWORLD. It's things like the limitations in high

MicroBee with clear cover.

HIGH RESOLUTION, HIGH VISIBILITY GRAPHICS

MicroBee brings you unsurpassed graphics facilities under easy to learn BASIC control. In low resolution mode (128x48 units) you can generate 'chunky' graphics and run Tandy programmes. For finer control a couple of keystrokes, switch you to high resolution graphics (512x256 units) and still let you combine them with text. Doing all this is easy for MicroBee. It shares the same intelligent VDU controller IC with IBM's new personal computer. So, like the IBM, MicroBee has a fully programmable screen display. MicroBee's standard 16 line by 64 character upper/lower case format can be updated to the professional 80x24 format to run CP/M programs. No need for expensive add ons.
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Only MicroBee brings you this great facility. You can hold programs and data in continuous memory when you switch off, or move to a new location. There's no longer any need to store on cassette or floppy discs at the end of the day. A power failure doesn't mean the loss of valuable programs or data. An inbuilt battery holds everything in memory until power is restored or you switch on again. MicroBee, your portable terminal.
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Your MicroBee is fully equipped to interface and communicate with the outside world. The programmable RS232 standard port means connecting a serial printer, modem or another computer is as simple as plugging it in. MicroBee's built in software means you're ready to run at 300 or 1200 baud. When you're ready to go further, use MicroBee's parallel port and connect up joysticks, Centronics type printers or any other peripherals needing a parallel port. Even the cassette interface has something special. It will store and load programmes at 300 or 1200 baud in either BASIC or Z80 code as well as letting you merge lines into an already existing BASIC program.
MicroBee works happily with your ordinary audio cassette recorder, and gives you a good load and save every time, even at the higher (1200 baud) rate. It's as simple as plugging it in with MicroBee.

microbee does

EXPANSION POWER

If you're not sure how you'll be using your MicroBee in the future, we've thought of that too. MicroBee is designed for inexpensive future expansion. The basic MicroBee with 16K of user RAM easily converts to 32K with a changeover board. Adding ROM (Read Only Memory) up to 28K is as easy as plugging it in to the memory board. Want S100 expansion? MicroBee goes one better. Its unique Z80 expansion bus lets your MicroBee interface with S100 as well as all the other expansion busses.

And if you're thinking of using disc drives and want to be able to run world standard CP/M Software, MicroBee's still with you. The soon to be released memory board and factory mod convert your MicroBee to 48K RAM, running CP/M with the ability to take disc drives. So you can run the same programs as IBM, DEC, Xerox and HP do on their Micros. MicroBee, ready when you are.

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Programming has never been simpler. Novice or experienced programmer, you'll find MicroBee's 16K BASIC in ROM a delight to use. MicroWorld gives you everything you get with other BASICs plus extra help. Like special error reporting and editing. And support of the built in sound and graphics facilities. So MicroBee's powers aren't hard to use. The BASIC also controls printers and modems. Writing programs is simpler because of the BASIC's search and replace ability. When you want to go further, **MicroWorld Editor/Assembler** helps you use Z80 code and write USR subroutines. It's in ROM for instant access. Or get going right away with **Cassette Programs.** From only $6.95 each. Chose from games like Chase, Target, ZTrek, Solitaire, Wumpus, Biorythm, Calender Maker or utilities like Typing Drill, Diagnostic, Textmaster.

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As a MicroBee owner, you'll become a member of the MicroWorld Users' group, and receive our newsletter and updates. Your kit comes on 14 day satisfaction guarantee. And there's a $50 complete cover service coupon if you have trouble.

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microbee

more, simply

resolution graphics that should be considered as serious, as this is a design fault which cannot easily be remedied.

The MICRO-BEE comes in kit form, and must be assembled by the owner before it can be used. It does not look too difficult to put together, but experience with soldering is essential. If you have never soldered before, it would not be a good idea to learn by putting together this kit. Preferably grab a friend who has soldering experience to help. Applied Technology separates the components into about half a dozen different containers to make identification easier. They also include resistor colour codes in the assembly instructions. The instructions seem clear, and are organised into a "tick the box" format. Everything you need is included in the kit (except a soldering iron, experience, etc.) including power supply, case, chasis, keyboard and IC sockets.

Applied Technology includes a "no apologies" coupon with each machine. If you get stuck at any point in the construction of the machine, send it to them along with the coupon and $50.00 and they will complete the machine, test it for you and send it back. The manual stresses that if you are not too sure about something, use the "no apologies" coupon rather than risk ruining the kit. The coupon is invalid if you have caused too much damage to the machine. In general, the contruction does not appear too difficult and I think that anyone with a reasonable amount of experience should have no trouble in getting it to work. I imagine that some people might be put off by the fact that the Micro-Bee is a kit, which is unfortunate as it is quite a machine. I would hope that Applied Technology brings out an assembled and tested version of the computer as they would probably find they would sell many more machines.

Documentation

The documentation included with the machine is a construction manual, a Basic manual and a copy of the insert which recently featured in "Your Computer".
The assembly manual is excellent in all respects. The copy of the insert is vague and far from complete, at one moment trying to explain things in layman's terms, and at the next moment dropping in terms such as "classic Von Neumann architecture". The documentation seems confused about what the machine can do and contradicts itself concerning volatile memory. At one point it says the machine uses non-volatile CMOS RAM, and then later it says the memory is battery backed. I tried turning the computer off for 30 seconds and found that it is neither!
The Basic manual covers each statement, function and command in turn, but does not go so far as to cover such things as expressions, statement coding and layout rules, etc. The documentation is adequate as a first draught, but needs to be totally reworked to bring it up to the quality other manufacturers are producing.

MicroBee with cover and coreboard removed.

Expansion

Despite the one or two criticisms I made of the Micro-Bee, I must say that I was extremely impressed with it. There was more to review than I had expected, given its size and cost. Its biggest problem is the "assemble it yourself" aspect, as I am sure many potential buyers will shy away. Its other main problem is the competition offered by the low cost colour machines, but I think you will find that the Micro Bee offers more computing power for your dollar.
It's a good machine, it's Australian designed, and I definitely think that it is worth considering in your next micro-purchase.

Conclusion

The machine is organised internally with all the memory on the one board. At the base model, this board contains 16k of RAM and 16k of ROM, with room for an additional 16k of RAM on the same board. The "core" board, as it is referred to, can be removed and replaced with a board containing 48k of RAM for running in a disk based CP/M environment. At the moment there is no news concerning disks, printers and light pens, but apparently an S-100 expansion interface is on its way, which should open the machine to a whole world of expansion.
The 16k upgrade is available in kit form for a cost of $120.

BENCHMARK TIMINGS	(all times are in seconds)		
BM - 1	2.7	BM - 5	20.9
BM - 2	10.0	BM - 6	39.4
BM - 3	18.1	BM - 7	67.3
BM - 4	17.9	BM - 8	see text

TECHNICAL SPECIFICATION	
CPU	Z80, 2 MHz
RAM	16k CMOS
ROM	16k, MICROWORLD
Cassette	1, 300 or 1200 baud
Serial Port	RS-232, 300 or 1200 baud
Screen	16 lines of 64 characters Hi-res 512 x 256 Lo-res 128 x 48
Keyboard	60 keys
Languages	Basic
Sound generator	24 tones
Video output	B & W, direct video output.

DIARY DATA

Readers are strongly advised to check details with exibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printer's errors, etc. Organisers are requested to notify APC of forthcoming events well in advance to allow time for inclusion in 'Diary Data'.

Hanover, Germany	Hanover Trade Fair	April 21–28, 1982
Sydney	Computers – How they work and what they do. Tel: (02) 232 6366	April 22–23, 1982
Melbourne	CETIA, Melbourne Exhibition Buildings	June 1–4, 1982
Sydney	Data 82, Centrepoint, Contact: Graphic Directions	August 10–12, 1982
Canberra	National Microcomputer Conference, Contact: MICSIG, ACS	August 18–20, 1982
Melbourne	Data 82, Melbourne Showgrounds	November 9–11, 1982
Sydney	The 1st Australian Personal Computer Show, Centrepoint, Contact: Australian Exhibition Services	March 10–12, 1983

USER GROUPS INDEX

Below is a list of alterations and additions to the list of user groups published in the March issue.

Perth '80 User Group. Meetings are held at the Community Recreation Hall, Macdonald Street, Yokine on the first Tuesday of each month at 7.30pm. System 80 and TRS-80 users are welcome at meetings. For more information contact C. Powell (09) 457 6849.

Ballarat Computer Users Group
Membership is $5.00 per annum to cover postage of newsletter. Meetings on the first Thursday of each month at the Hopetoun Street Community Education Centre in Ballarat. Interested persons can contact the Publicity Officer, John Preston, (053) 31 4363.

Hewlett Packard User Group
Meetings are held as notified at 121 Wollongong Street, Fishwick. For more information, contact Claire Maguire (062) 80 4244 (BH).

OMEGA – Ohio Scientific. Meetings are held the third Wednesday of every second calendar month. Contact: Geoff Cohen (062) 49 2688 (BH).

PET User Group. Meetings are held every Saturday at Scott House, 219 London Circuit, Civic. More details are available from Greg Wilkins (062) 512 3836.

Queensland Sorcerer Users Group (QSUG). Meetings are held on the last Sunday of each month at the Queensland University. Annual membership fee is $10. For more information contact G. Snell (04) 205 1017.

Northern Territory Micro Computer Users Group. Meetings are held on the first Sunday of every month at 96 Freshwater Road, Jingili, Darwin. Further details may be obtained from the address above or write to H. Stockdale, 4 Bellara Street, RAAF Base, Darwin, 5789.

NETWORK NEWS

Here is a list of all Australian personal computer networks. As more networks appear – and as more facilities are added to existing ones – we'll report them in this section, which appears monthly.

The Australian Beginning. Operator: The Australian Beginning Pty. Ltd. 364 La Trobe Street, Melbourne. Tel: (03) 329 7998. Facilities: Information service, electronic mail, software storage, and software downloading. Hours: 24 hours/day, 7 days/week.

INFONET. Operator: Network Services Division of Computer Sciences of Australia Pty. Ltd., 460 Pacific Highway, St Leonards, NSW. Tel: (02) 439 0033. Facilities: Access to databases produced by the Australian Bureau of Statistics and the Institute of Economic and Social Research. Hours (E.S.T.): Monday to Friday (7am to 9pm), Saturday (8am to 5pm) and Sunday (8am to 11.30am).

AUSINET. Operator: ACI Computer Services, P.O. Box 42, Clayton, Victoria. Tel: (03) 544 8433. Facilities: Medium to databases whose subject coverage includes agriculture, education, energy, industry, public affairs, science and technology and an online Australian database directory. Hours: 8.30am to 9.00pm E.S.T. Monday to Friday.

CSIRONET. Operator: CSIRO Division of Computing Research, P.O. Box 89, East Melbourne. Tel: (03) 419 1333. Facilities: Carries a broad range of scientific and technological databases compiled in Australia and overseas, including general scientific research, renewable energy resources, agriculture, water resources, mining and geology, and thermodynamics.

IP Sharp Associates Network. Operator: IP Sharp Associates Pty. Ltd., 13th Floor, 175 Pitt Street, Sydney. Tel: (02) 232 6366. Facilities: The network is an international time sharing data processing network, the host computers being located in Toronto, Canada. Hours: 24 hours/day, 7 days/week.

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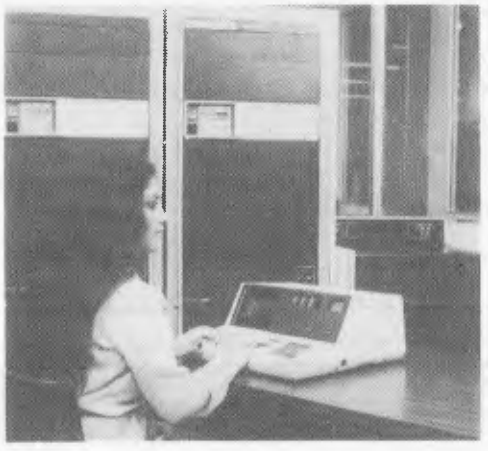

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The AUSTRALIAN BEGINNING can be accessed through a number of 'approved' personal computers, and terminals, by use of an accoustic coupler or modem.

Users will receive a number of benefits which will include:

INFORMATION SERVICES

Members will have access to a number of information sources which will include the latest news, sports results, financial reports, and farm information.

NATIONWIDE COMMUNICATION

Members will be able, also, to communicate nationwide with other AUSTRALIAN BEGINNING members through our system.

THE AUSTRALIAN BEGINNING RECOMMENDS 3M DISKETTES

SOFTWARE BANK

Users will have access to a myriad of computer programs that will include entertainment, educational aids, programming and diagnostic tools, and financial applications.

MAINFRAME POWER

Users will have the capability to make use of the Mainframe's huge storage capacity by using any of our large programs, or storing your large programs on our system.

SHOP AT HOME

You can take advantage of our 'shopping by computer' system to get the best prices on a number of popular consumer items.

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You do not have to be a computer programmer to make use of the AUSTRALIAN BEGINNING. All of the instructions are in everyday English, so that even the younger members of your family will be able to operate the system.

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While services like these used to cost tens of thousands of dollars to the government departments and large corporations who used them, they are now available to you for less than the cost of a packet of cigarettes a day for the 'average' user.

You can join the AUSTRALIAN BEGINNING by paying a one-time joining fee of $100, and a small hourly user charge of $10 an hour 8 a.m. - 6 p.m. and $4.50 an hour 6 p.m. - 8 a.m. weekdays and all weekends.

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Model.....

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☐ *I am interested, but I need more information.*

DEALER INQUIRIES INVITED

Programs

We are interested in programs for any of the popular micros – please specify which one you wrote your program on and how much it uses up. We'd also prefer more 'serious' software: games are all very absorbing, but the programme section of APC does seem rather one-sided. Make sure programs submitted are fully debugged before they're sent in, preferebly on cassette with a clear listing enclosed. A short explanation of your program's function would also be desirable. If you want it returned, enclose an SAE and write your name and address on each piece of paper you send. Don't worry if you don't hear anything for a few months – programs take a long time to evaluate. And we pay for all programs we print. Send contributions to APC, 462 Burwood Road, Hawthorn, Vic. 3122.

Sincere thanks to everyone who has volunteered to join APC's referee scheme. Although we must now inform you that the number of volunteers is beginning to exceed demand and the register is closed to further applications. Those who have applied will be contacted with details of the scheme. And please keep sending in programs!

Hopefully before too long, we'll be seeing more programs written for new machines such as the Ataris, VIC-20, Peach and TRS-80 Color. You've read the tests, been to the shows, seen the adverts, now write the programs! There must be at least a few ardent keyboard bashers hiding one or another of the aforementioned under their TVs; there is a little evidence of this, but it's quite scarce. If you've having problems a carefully typed or, at last resort, hand-printed listing will be quite acceptable.

TRS-80 Reaction Timing

By MG Green

The program measures the time taken to react to a cross appearing on a screen (signified by pressing a key) and then compiles a histogram after a specified number of tries and calculates the mean and standard deviations which appear at the same time as the histogram. This one is in TRS-80/System 80 Basic and needs 14k.

```
80 CLS:DIM A(50)
90 PRINT TAB(20) "REACTION TIME PROGRAM":PRINT:PRINT
100 PRINT TAB(10) "AS SOON AS THE CROSS APPEARS PRESS ANY KEY"
110 REM
120 REM  THE FOLLOWING SECTION READS THE TIMING ROUTINE
130 REM  AND CONVERTS IT INTO A STRING
140 DATA 110000012400CD600013D5CD2B00D1FE0028F0626BC39A0A
150 READ A$
160 M$ = ""
170 FOR I=1 TO LEN(A$) STEP 2
180 N1 = ASC(MID$(A$,I,1)): N2 = ASC(MID$(A$,I+1,1))
190 IF N1>57 THEN N1 = N1-7
200 IF N2>57 THEN N2 = N2-7
210 N = (N1-48)*16 + N2-48
220 M$ = M$ + CHR$(N)
230 NEXT I
240 REM
250 PRINT:PRINT:INPUT "HOW MANY TRIES";NT
260 FOR I=0 TO 50:A(I)=0:NEXT
270 S1=0:S2=0:SM=0
280 GOTO 300
290 PRINT:PRINT:INPUT"HOW MANY MORE TRIES";NT
300 CLS:PRINT TAB(25) "GET READY"
310 FOR I=1 TO 500:NEXT
320 CLS
330 IT=0
340 REM
350 REM  LOOP FOR EACH TRY BEGINS HERE WITH THE SELECTION
360 REM  OF A RANDOM TIME BEFORE THE CROSS APPEARS
370 REM
380 IT = IT+1
390 IF IT>NT THEN 690
400 N = 500 + RND(1000)
410 REM
420 REM  POKE THE ADDRESS OF THE START OF THE TIMING
430 REM  ROUTINE INTO THE CORRECT ADDRESSES
440 BE = VARPTR(M$)
450 POKE 16526, PEEK(BE+1)
460 POKE 16527, PEEK(BE+2)
470 FOR I=1TON:NEXT
480 REM
490 REM  THE TIMING ROUTINE IS CALLED HERE AND RETURNS
500 REM  THE DELAY IN MILLI-SECONDS.
```


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```
510 PRINT@160,"X"
520 N=USR(0)
530 PRINT@284,N;"MSEC";CHR$(30)
540 FOR I=1 TO 500:NEXT
550 CLS
560 REM  INCREMENT COUNTERS FOR CALCULATION OF MEAN
570 REM  AND STANDARD DEVIATION
580 REM  AND STORE TIME IN HISTOGRAM
590 S1 = S1 + N
600 S2 = S2 +N[2
610 SM = SM + 1
620 N = INT(N/10) + 1
630 IF N<51 THEN A(N)=A(N)+1
640 GOTO 380
650 REM
660 REM  END OF TRIES
670 REM  SORT AND PRINT THE RESULTS AS A HISTOGRAM
680 REM
690 F3$="$$$"
700 CLS
702 REM  MB NORMALISES THE HISTOGRAM
704 REM  MB = 20 IS MORE SUITABLE IF THE HISTOGRAMME
706 REM  IS OUTPUT TO A PRINTER.
710 MA = 0: MB = 10
720 FORI=0TO50
730 IF A(I)>MA THEN MA=A(I)
740 NEXTI
750 IF MA=0 THEN PRINT "NO DATA TO HISTOGRAMME": GOTO 1050
760 IX=INT((MA-1)/MB)+1
770 NA=INT(MA/IX)+1
780 FORI=1TONA
790 Y=IX*(NA+I-1)
800 PRINT USING F3$;Y;:PRINT":";
810 FORJ=1TO50
820 RE=Y-A(J)
830 CH$=" "
840 IF RE>=IX THEN 870
850 IF RE<=0 THEN CH$="X":GOTO870
860 CH$=CHR$(IX-RE+48)
870 PRINT CH$;
880 NEXTJ
890 PRINT
900 NEXTI
910 PRINT"     -";:FORI=1TO5:PRINT"----------+";:NEXTI:PRINT
920 PRINT"     0 ";:FORI=1TO5:PRINT"         ";I;:NEXTI:PRINT
930 PRINT"       ";:FORI=1TO5:PRINT"          0";:NEXTI:PRINT
940 PRINT"       ";:FORI=1TO5:PRINT"          0";:NEXTI:PRINT
950 REM
960 REM  NOW CALCULATE THE MEAN AND STANDARD DEVIATION
970 REM  AND PRINT THEM
980 REM
990 ME = INT(S1/SM)
1000 SD = (S2-SM*ME[2)/(SM-1): SD = INT(SQR(SD))
1010 PRINT:PRINT TAB(10) "MEAN";ME;TAB(40) "STD DEV";SD
1020 REM
1030 REM  SELECT CONTINUATION
1040 REM
1050 PRINT TAB(18) "HIT ANY KEY TO CONTINUE";
1060 AN$=INKEY$:IFAN$="" THEN 1060
1070 CLS
1080 PRINT "HIT A KEY AS FOLLOWS:-"
1090 PRINT TAB(10) "'A' TO ADD MORE TRIES"
1100 PRINT TAB(10) "'R' TO RESTART THE PROGRAM"
1110 PRINT TAB(10) "ANY OTHER KEY TO END"
1120 AN$=INKEY$:IF AN$="" THEN 1120
1130 IF AN$="A" THEN 290
1140 IF AN$="R" THEN 250
1150 END
```

ZX81 Graphplot

by N Angell

This runs in 1k and will plot a graph for a large variety of equations of the form y=2x; y=x² +4; y=1/x (y in terms of x). It requests the equation and then works out maximum values for x and y thereby dividing the screen appropriately. This done, it will plot the graph using the previously deduced volumes as limits so that the graph does not run over the edge of the screen. It is useful for handling negative values in plotting graphs. The number or range of x values can easily be altered — see lines 110 and 120 — according to the equation used or the accuracy of plotting required.

```
10 REM "GRAPHPLOT"
20 LET I = Ø
```

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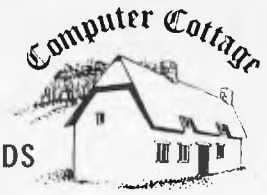

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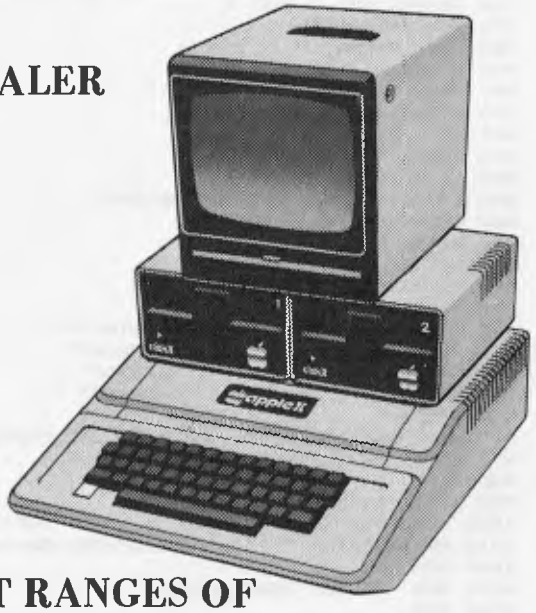

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```
 30 LET H = I
 40 LET P = I
 50 LET M = I
 60 LET C = -1
 70 PRINT "INPUT EQUATION NOW"
 80 INPUT A$
 90 CLS
100 PRINT "Y = ";A$
110 FOR X = -3 TO 3 STEP .5
120 IF X = Ø THEN LET X = .ØØ1
130 LET Y = VAL A$
140 IF C = -1 THEN GOTO 5ØØ
150 LET N = 4Ø / J
160 PLOT M , (Y + ABS I) * N
170 LET M = M + (6Ø / P)
180 PRINT INT Y
190 NEXT X
200 STOP
500 LET P = P + 1
510 IF Y > H THEN LET H = Y
520 IF Y < I THEN LET I = Y
530 LET J = Ø
540 IF SGN I = -1 THEN LET J = ABS I + H
550 IF SGN I = 1 THEN LET J = H - I
560 IF SGN I = Ø THEN LET J = H
570 NEXT X
580 LET C = Ø
590 GOTO 11Ø
```

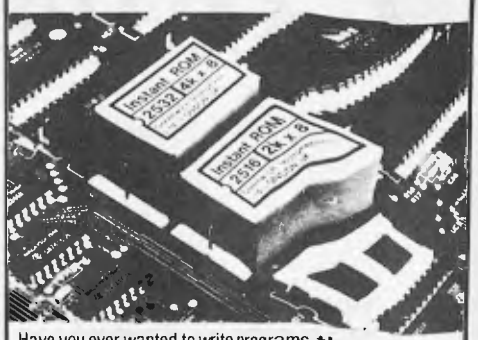
PET Cheese

by Paul Bradshaw

A game to run on 'new ROM' or 'Basic 4.0' PETs in 8k.
Instructions are in the game.

```
120 A=RND(0)
130 Z$="000000" HS$="00000"
140 GOSUB1180 REM * INSTRUCTIONS *
150 GOSUB640 REM * READ MOVEMENT DATA *
160 PRINT"J"
170 GOSUB1390 REM * INSTAL MACHINE CODE *
180 CC=18 REM * CHEESE COUNTER *
190 GOSUB480 REM * INITIAL DISPLAY *
200 POKE59464,0 POKE59467,16 POKE59466,15 REM * INIT. SOUNDBOX *
210 REM *** INITIAL CAT POSITION ***
220 C=32768+INT(RND(1)*1000) IFPEEK(C)<>32THEN220
230 POKE16,INT(C/256) POKE15,C-256*PEEK(16) POKEC,81
240 POKE177,2 REM * 2=CAT SPEED-CAN BE ALTERED *
250 SYS826 REM *-INIT. MACHINE CODE FOR CAT MOVEMENT *
260 MC=0 SC=0
270 FORDL=1TO1000 NEXT
280 GOSUB740 MD=0 F=0 Z=M M=M-M+1
290 REM *** INITIAL WARNING ***
300 MC=MC+1 FORJ=1TO50 POKEZ,160 POKEZ,96 POKE59464,200-I*2 NEXT
310 POKE59464,0
320 REM *** MOVE MOUSE ***
330 Z=M M=M+M(D) MD=MD+1
340 IFPEEK(M+1)=32ANDRND(1)<.38THENM=M+1
350 IFPEEK(M+1)=160ANDPEEK(M)<>160THENM=M+1
360 IFPEEK(M-1)=160ANDPEEK(M)<>160THENM=M-1
370 IFPEEK(M)=32THEN440
380 IFPEEK(M)=81THENPOKEZ,32 GOSUB790 GOTO270
390 IFPEEK(M)<>160THEN430
400 POKEZ,32 POKEM,32 CC=CC-1 GOSUB910
410 IFCC=0THEN1030
```


INSTANT ROM



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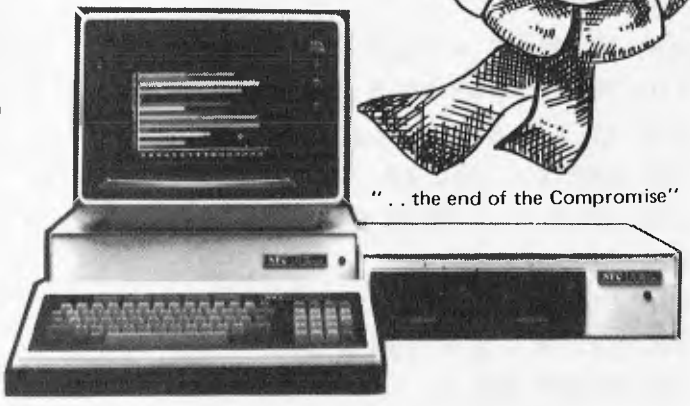

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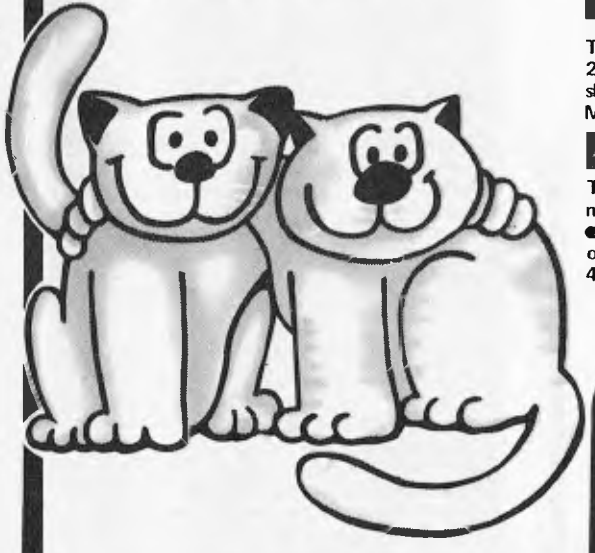

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```
420 GOTO270
430 IFPEEK(M)=255THENGOSUB980:M=Z:GOTO330 REM * REBOUND *
440 IFF=1THENPOKEZ,32:REM * DELETE OLD MOUSE *
450 F=1
460 POKEM,46:REM * INSERT NEW MOUSE *
470 GOTO330
480 REM *** INITIAL DISPLAY ***
490 PRINT"□"
500 FORJ=32768TO32807
510 POKEJ,255:POKEJ+40,255:POKEJ+920,255:POKEJ+960,255
520 NEXT
530 FORJ=32768TO33728STEP40
540 FORK=0TO2
550 POKEJ+K,255 POKEJ+39-K,255
560 NEXT
570 NEXT
580 PRINT"■■■■■■■■■■■■■■";
590 FORJ=1TO3
600 PRINTTAB(17)"■
610 NEXT
620 PRINT"■"TAB(6)"■SCORE  00000     HIGH  "HS$
630 RETURN
640 REM *** READ MOVEMENT DATA ***
650 FORJ=1TO4:READM(J):NEXT
660 DATA39,41,-39,-41
670 REM *** READ SOUND EFFECTS DATA ***
680 FORJ=1TO4:READS(J):NEXT
690 DATA254,200,170,127
700 REM *** REBOUND DATA ***
710 R(1)=2:R(2)=1:R(3)=4:R(4)=3
720 Q(1)=4:Q(2)=3:Q(3)=2:Q(4)=1
730 RETURN
740 REM *** RANDOM MOUSE STARTING POSITION AND DIRECTION ***
750 IFRND(1)>.5THENM=32851+INT(RND(9)*34)-800*(RND(1)>.5):GOTO770
760 M=32851+INT(RND(1)*21)*40-33*(RND(1)>.5)
770 D=INT(RND(1)*4+1):IFPEEK(M+M(D))<>32THEN770
780 RETURN
790 REM *** MOUSE EATEN ***
800 FORJ=1TO4
810 POKE59464,S(J)
820 FORK=1TO50:NEXT
830 NEXT
840 POKE59464,0
850 S1=INT((SC+450-MD*5)/10)*10
860 IF S1>SCTHENSC=S1
870 S$=MID$(STR$(SC),2)
880 L=LEN(S$):IFL<5THENS$=LEFT$(Z$,5-L)+S$
890 PRINT"■"TAB(6)"■SCORE  "S$"     HIGH  "HS$
900 RETURN
910 REM *** CHEESE EATEN ***
920 FORJ=0TO200STEP20
930 POKE59464,J
940 FORK=1TO10:NEXT
950 NEXT
960 POKE59464,0
970 RETURN
980 REM *** REBOUND ***
990 POKE59464,128
```

Superboard II Spin-Fighter

by Robert Dunstan

This program can be used with a standard superboard (24 x 24 screen format).

To make the game more exciting, tune 'out' an FM radio beside the computer to give 'sound effects'.

```
 2 REM*           SPIN-FIGHTER           *
 3 REM*           BY R.DUNSTAN           *
 4 REM*     FOR O.S.I.SUPERBOARD II      *
10 FORYY=1TO32:PRINT:NEXTYY
12 PRINT"       SPIN-FIGHTER":PRINT"
  ---------------"
14 PRINT"You are at the centre"
15 PRINT
16 PRINT"  of the screen."
17 PRINT
18 PRINT"You can spin around "
19 PRINT
20 PRINT"and fire at the rockets"
21 PRINT
22 PRINT" 1-Spins anticlockwise"
23 PRINT
24 PRINT" 2-Spins clockwise"
25 PRINT
26 PRINT" 7-Firing button"
27 PRINT
28 PRINT"Your aim is to stay"
```


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```
  20 PRINT
  30 PRINT"alive as long as"
  31 PRINT
  32 PRINT"    possible!"
  34 PRINT:INPUT"READY";Q$
  36 IFLEFT$(Q$,1)<>"Y"THEN34
  40 PRINT:PRINT
  50 FORYY=53381TO54269:POKEYY,46:NEXTYY
  80 MP=11
  90 K=57000:POKE530,1:POKEK,127
 100 DIMA(8,3),B(8,3)
 105 REM** ROCKET BASES & DIRECTIONS **
 110 FORX=1TO8
 120 FORY=1TO3
 130 READQ
 140 A(X,Y)=Q
 150 NEXTY
 160 NEXTX
 170 DATA53479,33,19,54138,-33,23,53408,
32,20,54128,-32,18
 180 DATA53498,31,21,53818,-1,22,54118,-
31,17,53798,1,18
 190 CC=53888
 1000 REM** TURRET DIRECTIONS **
 1010 FORX=1TO8
 1020 FORY=1TO3
 1030 READQ
 1040 B(X,Y)=Q
 1050 NEXTY
 1060 NEXTX
 1070 DATA-32,248,140,-31,249,189,1,250,
132,33,251,190
 1075 DATA32,252,140,31,253,189,-1,254,1
32,-33,255,190
 1080 TD=-32:TS=248:TR=140
 1090 POKECC,248
 1095 REM***** ROCKET FIRING *****
 1100 G=INT(RND(39)*8+1)
 1101 IFHH>4THEN4000
 1105 FF=0
 1110 X=A(G,1):Y=A(G,2):Z=A(G,3)
 1130 POKEX-Y,32:POKEX,Z
 1135 IFX+Y<>53888THEN1141
 1137 POKEX,32
 1138 POKE53888,187
 1139 FORYY=1TO200:NEXTYY
 1140 POKECC,B(MT,2):HH=HH+1:GOTO1100
 1141 IFCC+MP*TD=XTHEN3000
 1145 GOTO2000
 1146 FF=FF+1
 1147 IFFF<5THEN1155
 1150 X=X+Y
 1155 FORYY=1TO20:NEXTYY
 1160 GOTO1130
 2000 REM****PLAYER MISSILE*********
 2010 IFPEEK(K)=191THENMT=MT+.5
 2020 IFMT=9THENMT=1
 2030 IFPEEK(K)=127THENMT=MT-.5
 2040 IFMT<1THENMT=8.5
 2050 POKECC,B(MT,2)
 2060 IFMP<10THEN2100
 2070 IFPEEK(K)<>253THEN2500
 2075 MP=1
```

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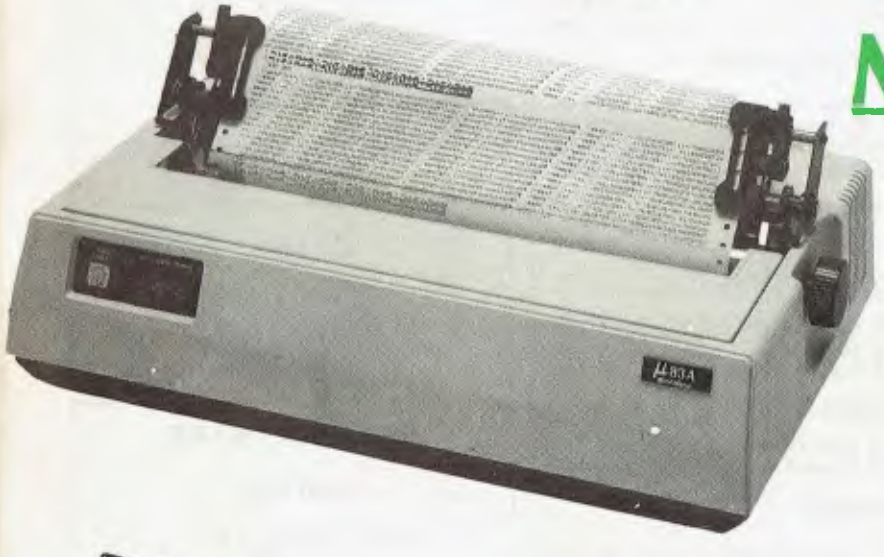

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2100 MP=MP+1
2110 POKECC+(MP-1)*TO,32
2120 POKECC+MP*TO,TR
2130 IFCC+MP*TO=XTHEN3000
2135 IFMP<10THEN2100
2500 GOTO1146
2990 REM**** ROCKET HIT ****
3000 POKEX,161
3005 SC=SC+1000
3010 FORYY=1TO100:NEXTYY
3015 POKEX,32
3020 MP=11
3030 GOTO1100
3990 REM**** END GAME ****
4000 FORYY=1TO32:PRINT:NEXTYY
4010 PRINT"SCORE IS";SC
4020 PRINT:INPUT"ANOTHER GO";A$
4030 IFLEFT$(A$,1)="Y"THEN RUN
4040 IFLEFT$(A$,1)="N"THEN4060
4050 GOTO4020
4060 POKE530,0
4070 END
```

TRS-80 Extra

By Francis Butters

```
10 '    TAB
20 '
30 CLEAR500
40 GOSUB110
50 FORX=1TO55:LPRINTCHR$(138):NEXT
60 GOSUB110
70 FORX=1TO7:LPRINTCHR$(138):NEXT:END
80 '
90 '    PRINTING GOSUB
100 '
110 A=10:LPRINTSTRING$(3,32);:FORX=1TO7:LPRINTSTRING$(2,32)"5"STRING$(3,32)A;:A=
A+10:NEXT:LPRINTCHR$(13)
120 FORX=1TO8:LPRINT"x"STRING$(9,".");:NEXT
130 RETURN
```


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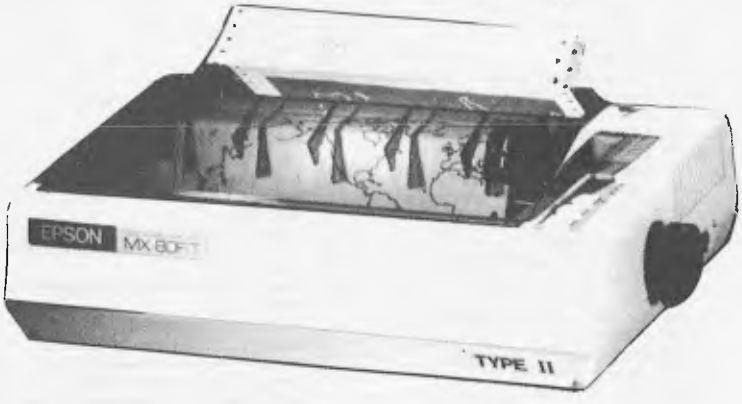

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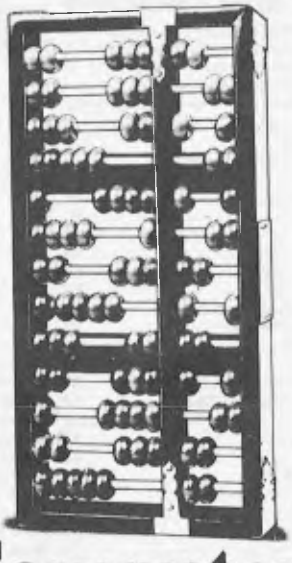

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New formats appear in green.

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BASF System 7100 ..... RD
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CDS Versatile 4 ..... Q2
Columbia Data Products 8 in. A1
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CPT 8000 ..... A1
Cromemco System 3 ..... A1
Cromemco System 2 SD/SS R6
Cromemco System 2 DD/SS ..... RX
Cromemco System 2 DD/DS ..... RY
CSSN Backup T1
Datapoint 1550/2150 ..... A1
DEC VT18X ..... SD
Delta Systems A1
Digi-Log Microterm II ..... RD
DTC Micro 210A ..... SC
Durango F-85 ..... RL
Dynabyte DB8/2 ..... R1
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Exidy Sorcerer + Exidy CP/M-80 8 in. A1
EXO A1
Findex P6
Heath H8 + H47 ..... A1
Heath H89 + Magnolia CP/M-80 ..... P7
Heath H89 + Heath CP/M-80 ..... P7
Helios II B2
Hewlett-Packard 125, 5.25 in. ..... SB
Hewlett-Packard 125, 8 in. A1
iCOM 2411 Micro Floppy R3
iCOM 3712 ..... A1
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IMSAI VDP-42 ..... R4
IMSAI VDP-44 ..... R5
IMSAI VDP-80 ..... A1
Industrial Microsystems 5000 ..... RA
Industrial Microsystems 8000 ..... A1
Intel MDS SD A1
Intertec Superbrain DOS 0.1 ..... R7
Intertec Superbrain DOS 0.5-2.x ..... RJ
Intertec Superbrain DOS 3.x ..... RK
Intertec Superbrain QD ..... RS
ISC Intecolor 8063/8360/8963 ..... A1
Lexitron VT1303 DS/DD S8
Lexor Alphasprint Model S1 ..... S1
Meca Delta-1 5.25 in. P6
Micromation A1
MicroMega 85 ..... SC
Micropolis Mod I Q1
Micropolis Mod II Q2
MITS 3200-3202 ..... B1
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Mostek A1
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NEC PC-8001 ..... RV
NNC-80 ..... A1
NNC-80W A1
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Osborne 1 ..... SA
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Quay 500 ..... RQ
Quay 520 ..... RP
RAIR DD ..... RE
Research Machines 5.25 in. ..... RH
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Sanco 7000 5.25 in. ..... RQ
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COMPETITION RESULTS

Although it appears unlikely that most of Australia's writing ability, in the field of microcomputing, would come from North Adelaide, certainly two of the best three articles submitted in the *APC* printer competition came from this suburb.

Congratulations to Bruce Duncan (who wrote on the application of computers in analysing genetic trees), Mark Little (binary tree manipulation and decimal arithmetic on the Z80) and Russell Thamm (who wrote an editor for the Apple II), who will each receive a computer printer. A further twenty entrants have received a year's subscription to *APC* for their excellent articles.

APC would like to thank all readers who submitted entries to the Printer Competition.

PRINTER WINNERS:

Bruce Duncan, North Adelaide
Mark Little, Wynnum North
Russell Thamm, North Adelaide

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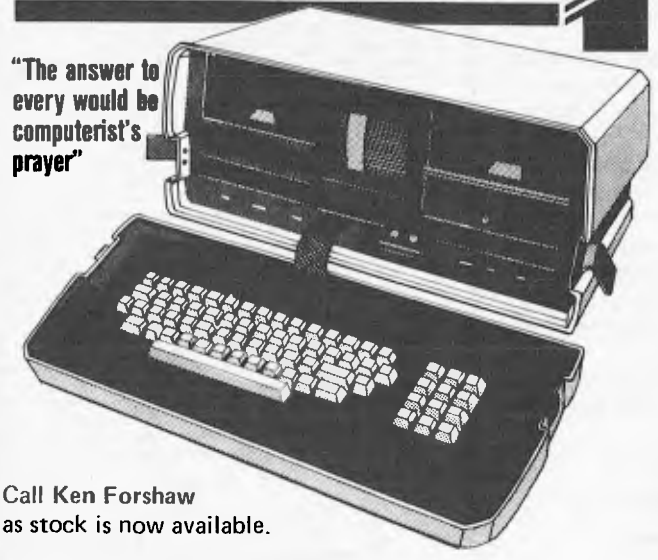

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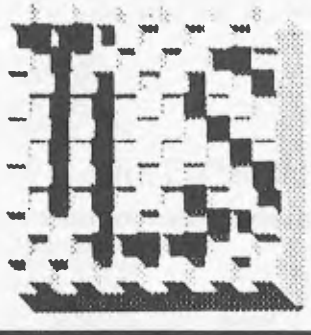

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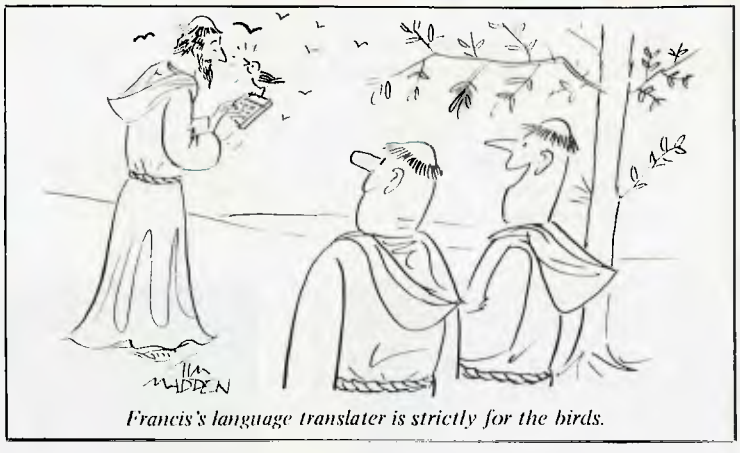
Lazing Around

By JJ Clessa



Francis's language translater is strictly for the birds.

As the February issue's "Lazing Around" went walkabout, I don't have any results to publish in this, the April, issue of *APC*. I am assured by the Editor such an horrendous blunder will not occur again (and ten strokes if it does).

PRIZE PUZZLE

Using the ten digits 0 — 9, construct two numbers such that the first is the cube and the second is the fourth power of the same number, x. What is the value of x?

Answers on *postcards*, please to: Lazing Around, *APC*, 462 Burwood Road, Hawthorn, 3122 to arrive no later than May 30, 1982.

QUICKIE

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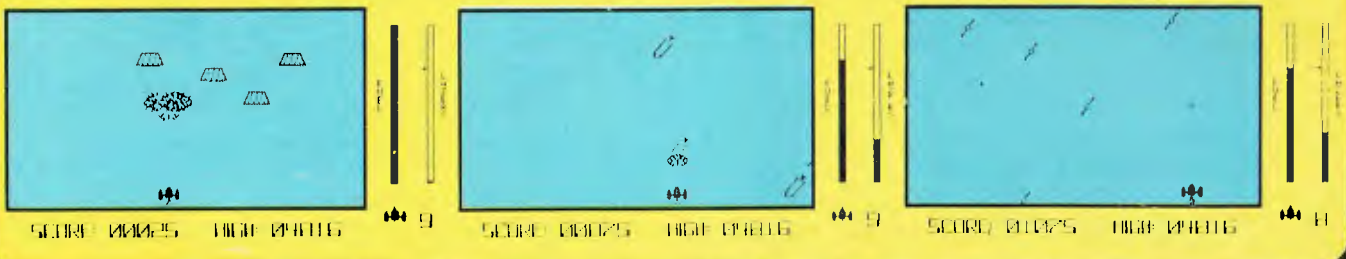

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